The Affordable Warmth Scheme

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Development of the 2018 targeting algorithm and associated technical reports

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Executive Summary

The Affordable Warmth Scheme (AWS) is Northern Ireland's Domestic Energy Efficiency Programme for vulnerable low income households. It is administered by the Department for Communities (DfC). In order to locate households most in need of assistance from AWS, the Department commissioned an area-based targeting tool which was developed by a team from Ulster University (UU), and first trialled in 2012. Versions of this tool have been in use since that time, through various phases of AWS. The algorithm is the main means by which households are initially identified as being potentially suitable under the AWS eligibility criteria.

Running in parallel to a Consultation Paper concerning a new Fuel Poverty Strategy for Northern Ireland, and in recognition of many other changes in the local fuel poverty landscape[1], UU was commissioned to:

- develop a revised algorithm;
- prepare a variety of technical documents associated with the algorithm;
- transfer the algorithm database to a GIS team at DfC.

The aims of the revised algorithm remain broadly the same: to identify small geographical areas in which the greatest concentration of need and vulnerability is located, vis-à-vis the prevalence and depth of fuel poverty. Focus remains on owner-occupied and privately rented properties.

This report provides details of how the algorithm was developed, along with a broader contextualisation of the status of fuel poverty in Northern Ireland and further afield.

Technical Report 1 provides up to date coverage of fuel poverty in a broad European context. The term has no official definition under the rubric of the European Commission, which has long stated that such an official definition would be impractical. There is no clear knowledge of how many European households experience fuel poverty, with estimates varying between 50M and 125M. Nor is the term fuel poverty the only one used to describe this phenomenon, with *energy poverty* being used in some Member States and *fuel poverty* in others – to add to the complexity, these terms are also defined differently.

Despite such diversity, most Member States acknowledge the scale of this socio-economic situation and that its negative impact translates into severe health issues and social isolation.

This recognition has led to the development of new and innovative ways in which energy poverty is being conceptualised, especially in mainland Europe. Issues related to *energy justice* are emerging as powerful new components of how policies are being formulated. This approach reframes fuel poverty into broader contexts beyond public health or energy efficiency - it distances itself from the quantitative techno-science of traditional approaches. Instead, fuel poverty is interpreted as '*a condition in which a household lacks a socially- and materially-necessitated level of*

[1] Such as changes in the cost differential for heating a home with kerosene versus gas, changes in the coverage provided by the domestic gas network, changes in the social housing register, etc.

energy services in the home'[2]. It focuses on the human consequences of energy poverty, interpreting these in the language of inequality, justice, and fairness.

The report argues that there is ample scope within a Northern Ireland strategy for a similar reform in terms of how fuel poverty is conceptualised. It could afford new opportunities for innovation and interdepartmental coordination, and would permit greater synergies with how energy poverty is being addressed throughout mainland Europe.

A concept widely debated in the energy/fuel poverty domain is that of ***vulnerability,*** and Technical Report 1 outlines how all-encompassing this concept has become. It describes some of the main variants in how the term is used in Europe, highlighting in particular:

- Variant 2 which endorses a capabilities framework - this opens up many new legitimate routes to assisting the fuel poor than have hitherto been in place;

- Variant 3 which ensures that the ***human*** elements of fuel poverty and the health impacts associated with it are not neglected.

In Technical Report 2, details are provided on the types of fuel poverty schemes being implemented in Europe. The predominant delivery strategy is housing retrofit, which means that the approach is largely technical and focuses on improved energy efficiency in homes. This reflects, in large part, the EU's more general tendency to seek technical solutions to human problems, but also reflects the fact that databases on housing are more advanced and more standardised across Member States than are databases concerned with health, wellbeing, domestic energy costs, or even income.

Whilst still chronically underfunded across Europe, fuel poverty alleviation schemes have met with considerable success. The Report chronicles several peer-reviewed publications, all published within the past year, which show considerable justification for investing in fuel poverty alleviation schemes – they appear to have the capacity to protect human health and wellbeing, whilst also acting as a vehicle for reducing health and social inequalities.

Technical Report 3 is concerned with advances in smart technologies and billing, and their potential for alleviating fuel poverty. Under EU Directives, all Member States have been obliged to carry out cost-benefit analyses (CBA's) of smart metering. Customers are seen as the main beneficiaries, although there are also greenhouse gas savings and significant revenues after meter replacement. Member State CBA outcomes have been variable, with 30% of States returning a negative CBA (indicating no positive outcome from a rollout). England and Ireland returned CBA's, and in England this was the case for both gas and electricity. Northern Ireland's CBA's (there have been 2 of them) have not been published, and the plans for smart metering remain difficult to ascertain.

Where smart meters have been installed in Europe, studies show that a smart meter accompanied by a support programme can reduce electricity consumption by

[2] http://journals.sagepub.com/doi/abs/10.1068/a38298

between 1% and 9.1%. Without support, reductions are consistently lower and range from a 1.1% increase in consumption to a 4% reduction.

For gas consumption, supported smart meter rollout can reduce consumption by between 1.2 and 4%, compared with 1.5% and 3% without support.

However, it is important to consider at this stage whether these estimates – based on studies carried out in regions beyond Northern Ireland - require attenuating in order to reflect the local conditions that prevail here. The Report concludes that the combination of two factors significantly limits the potential savings which could derive from smart metering in NI: first, the savings already levered in through prepayment meters, and second the high prevalence of fuel poverty in the region, which means that many households are already limiting their energy use as much as they can.

The Report concludes that there could still be reasonable scope for reducing NI's electricity consumption during a smart meter rollout, at a level approximating what has been estimated for neighbouring jurisdictions. But this will likely require sustained customer support and engagement, without which it would be unreasonable to believe that NI customers will be able to save the same as has been modelled for Ireland in their cost-benefit analyses for smart meter rollout, or even the more modest amounts estimated for GB. Lower incomes, the prevalence of fuel poverty, and the deep penetration of prepayment meters, will offset any modest potential for saving.

That being said, smart metering provides energy suppliers with half-hourly downloads of energy consumption for all households, and the potential of these data for identifying households most likely to be in extreme fuel poverty is immense. Should rollout commence in the foreseeable future, this advantage is a compelling one.

Technical Report 4 deals with targeting those most in need, and introduces the 2018 algorithm. It shows the extent to which targeting resources to where they are most needed is becoming a critical issue throughout Europe, but most especially in the UK. Here, it is evident that – other than NI - no other region of the UK has *developed* (and with Council support) also *delivered* a system of targeting which can be applied across the whole region. Furthermore the ability of NI's algorithm to identify Small Area Level geographies of fuel poverty is unique. The algorithm has also been tested in terms of validity across the whole of Northern Ireland, and delivers over 85% accuracy in terms of identifying households in fuel poverty. As such it is not only the most fully developed and tested model for area-based targeting, but it also represents many aspects of best practice in the field of cross-sector cooperation.

Technical Report 5 contains an account of UU consultations carried out with 9 of the 11 Councils who delivered AWS2. The report is in 2 sections. The first gives an account of Council experiences in implementing AWS2, and highlights their deep commitment to a scheme which, in their view "works". They were unanimous in believing it had greatly improved their delivery of energy efficiency services. Areas where challenges had been experienced included long waiting lists of clients in non-targeted areas, and levels of remuneration from DfC that they believed were too low. The second section details data sources they would have liked included in a revised algorithm, and UU's attempts to accommodate these. Access to core data that would improve targeting accuracy still further remains elusive.

Technical Report 6 contains a narrative summary of the process followed through the Excel spreadsheet. This includes full specification of the data collected, the selection and adjustment of key data, the indexing of variables, the averaging of variables (with weights as appropriate), the impact of access to the gas network and the calculation of the output used in the identification of targeted small areas.

Introduction

The recent past

The Affordable Warmth Scheme (AWS) is Northern Ireland's Domestic Energy Efficiency Programme for vulnerable low income households. It is administered by the Department for Communities (DfC). In order to locate households most in need of assistance from AWS, the Department commissioned an area-based targeting tool which was developed by a team from Ulster University, and first trialled in 2012. Versions of this tool have been in use since that time, through various phases of AWS. The algorithm is the main means by which households are initially identified as being potentially suitable under the AWS eligibility criteria.

The targeting tool consists of an algorithm built from a selection of databases which contain:

- data which contribute to how fuel poverty is defined and measured;
- data proxies for fuel poverty;
- indicators of vulnerability to the adverse health and wellbeing impacts of fuel poverty.

All of these data are coded at small area level.[3]

The outputs from the algorithm allow every small area in Northern Ireland (there are currently almost 5,000) to be allocated an eligibility score. The score reflects how many households in a particular small area are likely to be fuel poor, and what depth of fuel poverty the small area is likely to be experiencing.

The first phase of AWS took place in 2012. It consisted of a Pilot, in which the areas for targeting that were identified through the algorithm were surveyed by local Council energy efficiency teams, to assess the algorithm's validity and reliability. In total, 2,145 surveys were carried out throughout Northern Ireland; results suggested that almost 90% of households in target areas were indeed fuel poor, the majority of them in severe or extreme fuel poverty.

The second phase of AWS (AWS2) was launched in April 2015, and aimed to expand the programme. By September 2017, more than 20,000 households had been assisted by AWS2. DfC investment in AWS2 approximated £60,000.

The present

As part of an ongoing review of NI's Fuel Poverty Strategy, DfC has recently undertaken a stakeholder consultation regarding eligibility criteria for a new phase of AWS (AWS3), through which the views of stakeholders can be ascertained.

Running in parallel to this consultation, and in recognition of many other changes in the local fuel poverty landscape[4], UU has been commissioned to:

[3] A small area is a geographically defined unit which generally contains around 155 households. In the context of fuel poverty and targeting assistance from AWS, it can be used in conjunction with GIS mapping tools as a means of demarcating areas of greatest need.

- develop a revised algorithm;
- prepare a variety of technical documents associated with the algorithm;
- transfer the algorithm database to a GIS team at DfC.

The aims of the revised algorithm remain broadly the same: to identify small geographical areas in which the greatest concentration of need and vulnerability is located, vis-à-vis the prevalence and depth of fuel poverty. Prevalence and depth are, in turn, associated with adverse impacts on human health and wellbeing, making the necessity for finding households most in need particularly apposite. Focus remains on owner-occupied and privately rented properties.

The present report

As outlined by DfC, the purpose of this report is to build on the research which the original UU team carried out for the previous phases of AWS (AWS1 and AWS2). This earlier work was completed between 2012 and 2015. The new assignment comprises the next logical step in informing the development and rollout of a new Fuel Poverty Strategy.

The work being commissioned from UU includes:

- provision of a fuel poverty database and a suite of associated technical reports and user documentation;
- an assessment of the current approach taken by the Department to identify areas of good practice and identify opportunities for improvement;
- details of current approaches to alleviating fuel poverty elsewhere in the UK and Europe, as a means to inform how the Department may effectively tackle fuel poverty in the future.

The purpose of this new commission is to build on the experiences of the previous Affordable Warmth Scheme, so that – following the Fuel Poverty Review – an evidence-based and independent set of guidelines can be put in place for moving Fuel Poverty Strategy forward.

The report is intended to achieve three primary objectives:

- provide a fully updated fuel poverty database and a suite of associated technical reports and user documentation that will permit effective targeting of fuel poverty; the current database used for targeting is now 4 years old and – amongst other constraints - does not adequately reflect new geographic and census-based boundaries;

[4] Such as changes in the cost differential for heating a home with kerosene versus gas, changes in the coverage provided by the domestic gas network, changes in the social housing register, etc.

- deliver an independent review of the current approach taken by the Department, and identify opportunities for improvement;

- analyse approaches to alleviating fuel poverty which are operational elsewhere in Europe, with a view to further informing the Department on good practice.

Commissioning the UU team to complete this phase:

- affords continuity and natural progression;

- ensures that the evaluation of current practice continues to be independent;

- affords an opportunity to avail of expert analysis of evidence and good practice, both local and elsewhere in the UK/Europe.

The deliverables from the report are envisaged as follows:

- provision of a Fuel Poverty Database which will identify and rank areas most at risk of fuel poverty in Northern Ireland. This will be at the smallest level of geographic details as possible (in this case small area level);

- it will have the capacity to be aggregated into higher geographic area levels such as Wards and Local Government Districts;

- The database will take into consideration the aspects of fuel poverty attributable to 'poverty' (i.e. the degree to which household income contributes to fuel poverty and apply a relative weighting) and the aspects of fuel poverty attributable to 'property' (i.e. the degree to which the actual property characteristics contribute to fuel poverty and apply a relative weighting). In addition, it will incorporate (for the first time) aspects of vulnerability to the health and wellbeing impacts of fuel poverty, applying a relative weighting to these.

The Client Requirement includes the following vis-à-vis a targeting toolbox:

- a fuel poverty database capable of being converted to MS Access format from which in-built queries and reports can be run[5];

- A background report justifying the methodological approach undertaken in the development of the targeting database;

- A background report justifying the various base geographies which can be used for targeting;

[5] It was agreed that UU would not manage this conversion process as part of this commission

- An evaluation of current data sources and an assessment and recommendation on data sources which could supplement and improve the database;

- User documentation on how the database should be utilised, including how it can be updated as and when new data becomes available.

This Client Requirement will also deliver:

- an evidence-based review of the current approach taken by the Department, through an evaluation of feedback from Councils and analysis of the Department's experience in delivering the Affordable Warmth Scheme. This includes an assessment of the success of the Department's approach in tackling fuel poverty and the identification of further opportunities for improvement. This will incorporate research evidence from the use of targeting in other UK jurisdictions, and a critical assessment of whether these other approaches could be used to good effect in NI;

- a review of broader changes in European policies and strategies of relevance to tackling fuel poverty in Northern Ireland;

- a critical review of advancements in 'smart' technology and billing (e.g. smart metering, internet of things and smart controls) and consider how these can inform and enrich policies aimed at combating fuel poverty.

- An evidence-based set of recommendations regarding how often a fuel poverty strategy might need to be reviewed, and – in particular – at what transition points the targeting toolbox would need to be refreshed.

Technical Report 1

Fuel poverty and the European context

Energy poverty is deemed to be widespread across Europe, where it is estimated that between 50 and 125 million people are unable to afford proper indoor thermal comfort.

How fuel poverty is defined by Member States

A common European definition has not yet been adopted, although many member States have been calling for one since 2008. The European Commission has repeatedly stated that it does not support a European definition of fuel poverty, and that a common definition would be inappropriate due to the diverse energy contexts found across the European Union. However, a recent review of EU policy documents from 2001 to 2014, suggests that, contrary to the European Commission's stance, many EU institutions and consultative committees are in favour of a common European definition of fuel poverty. Most of these organisations believe that a definition is vital for raising the profile of fuel poverty and ensuring it is recognised as a policy issue by all Member States, particularly at a time of rising energy prices, stagnating wages and growing concerns about energy security and climate change[6].

To complicate matters further, some Member States focus on the traditional concept of fuel poverty, others focus on a newer and slightly different concept, namely energy poverty – the former is more commonly used in the UK and Ireland, the latter more frequently in mainland Europe. Energy poverty was introduced by Stefan Bouzarovski in the mid-2000's, and is defined as follows:

Energy Poverty[7]

'*A condition characterized by the inability of a household to secure materially and socially necessitated levels of energy services in the home. The meaning of the term 'necessitated' in this context is normally derived from relative and capabilities approaches, and normally refers to the level of energy services that enables full participation in the customs and practices that define membership in society, while maintaining a healthy indoor environment*'.

Whilst *fuel poverty* focuses on affordability of adequate energy services, *energy poverty* encompasses much more, including a household's inability to access suitable energy services, such as options for payment methods, access to priority customer programmes, and awareness of consumer protection laws. It embraces

[6] http://eprints.whiterose.ac.uk/105609/1/CSppp2march2016ACC.pdf

[7] http://journals.sagepub.com/doi/abs/10.1177/0969776415596449

broader societal issues of energy injustice, and as such is framed primarily as a concept which promotes inequality and exacerbates harm[8].

In France, energy poverty is generically understood to be 'the inability to keep homes adequately warm'. In France this generic description is further embellished, and has been officially co-opted into their official definition of energy poverty: hence, the Grenelle II Act defines energy poverty as 'a situation in which a person has difficulty obtaining the necessary energy in their home to meet their basic needs because of inadequate resources or living conditions'.

Hence, there is no EU-wide definition of fuel poverty or energy poverty. Countries use the terms differently and often interchangeably. However, a handful of Member States have their own (country-specific) definition of fuel/energy poverty (including Ireland and the UK). In the UK, two different definitions prevail (one for England, the other for Wales, Scotland and Northern Ireland), with a third likely to come into jurisdiction shortly (for Scotland).

Despite such diversity, most Member States acknowledge the scale of this socio-economic situation and that its negative impact translates into severe health issues and social isolation. In 2017, this was reflected in the launch of a major new initiative – the EU Energy Poverty Observatory[9], funded by the European Commission. It involves 13 organisations including universities, advocacy groups, think tanks, and the business sector. Over 100 internationally-renowned experts contribute to the Observatory, which plans to collect and publish Europe-wide energy poverty data while serving as the focal point of an emergent network of policy-makers, research scientists, advocacy groups and community activists. Meetings have already been convened in Athens, Ireland, Spain and France. A key focus of the Observatory is to enhance young researchers' competencies and opportunities. However, in the more medium-term, the Observatory is likely to focus on developing an official Europe-wide definition of energy poverty, as well as consensus on how it should be measured.

In March 2018, the European Commission also launched a call for proposals under a new programme, entitled Mitigating Household Energy Poverty, which will become an integral part of the EU's 2014-2020 Programme.

As a theme for investment and action, it is clear that energy/fuel poverty and health consequences are climbing steadily up the pan-European agenda.

How energy poverty is measured in European Member States

The term EU-SILC stands for European Union Statistics on Income and Living Conditions. The EU-SILC asks households to make yes/no responses to questions concerned with three indicators of fuel poverty. Responses are added together to produce a single score (0-3) denoting both the prevalence of fuel poverty in a particular Member State (a score of 1 or above), as well as the depth of fuel poverty (with a score of 3 being the most severe).

[8] http://www.gov.scot/Publications/2017/11/7715

[9] https://www.energypoverty.eu/

The EU-SILC metric

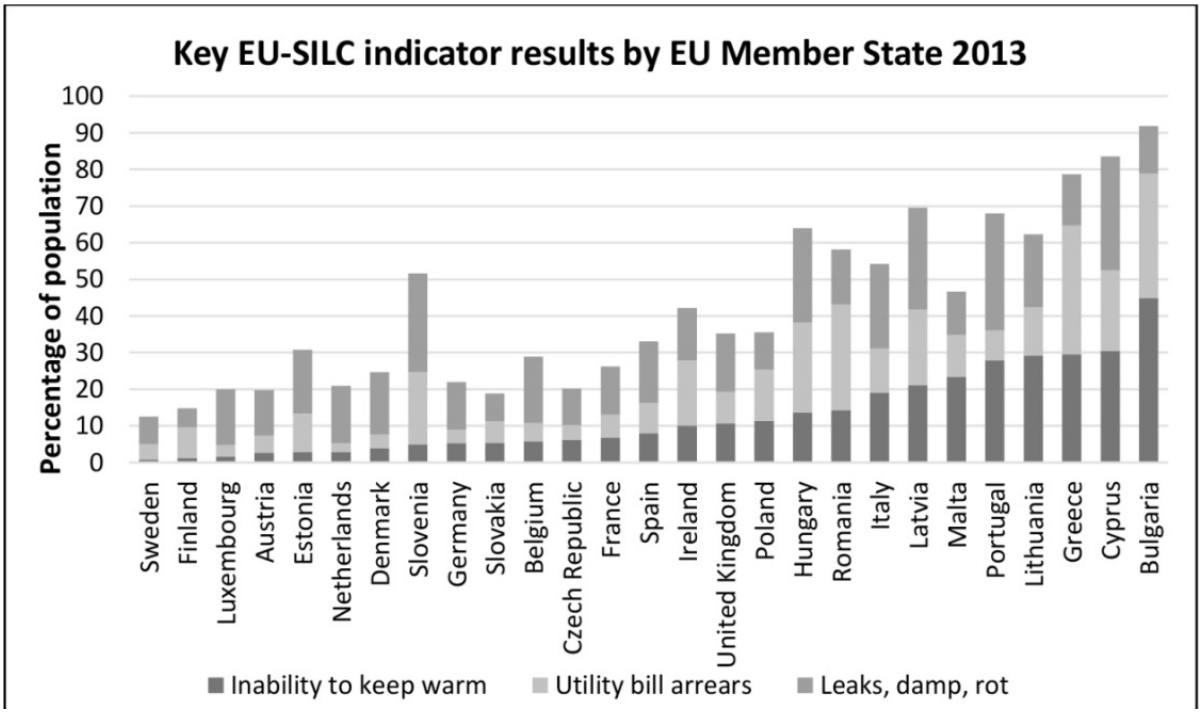
'*Have you been unable to keep your home adequately warm in the past year through lack of money?*

Have you been in arrears with utility bills in the last 12 months?[10]

Does your home have a leaking roof, or damp walls, or rotten windows?'

The EU-SILC definition approximates a technical definition, in that it yields prevalence data using a consistent metric (*extent*), and can identify who is most likely to be fuel poor (*demography*) and where they might be living (*geography*). On occasion, scores are compared across the Member States (see Figure 1). The timeline of results from European surveys (2005-2013) can be seen in Figure 2.

Figure 1: Fuel poverty in Europe: consensual indicator

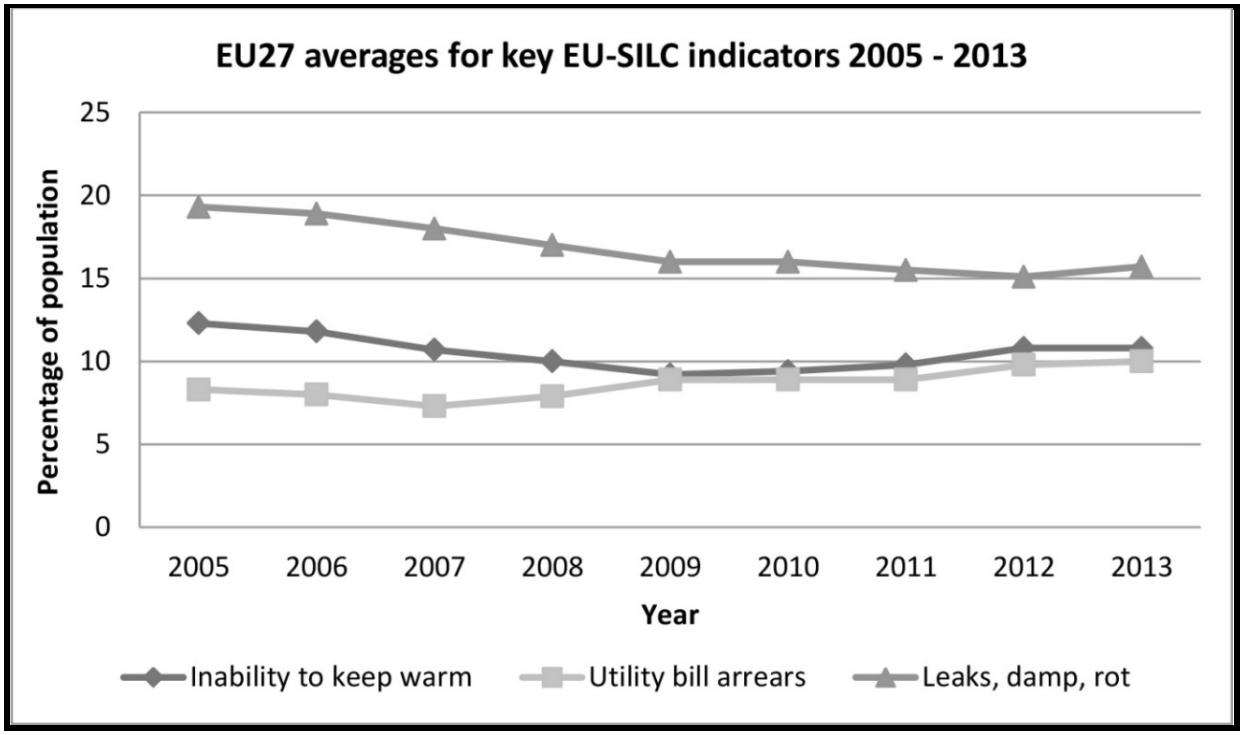


The latest EU-SILC estimates of fuel poverty in Europe (from 2014) show that the inability to keep homes adequately warm is most prevalent in Bulgaria, followed by Cyprus, Portugal and Greece i.e. countries which are considered to have a warm climate with mild winters. In colder Northern countries such as Sweden, Estonia, Denmark and Finland, the percentage of the population unable to have an adequately warm home is low compared to the EU average. These results for energy poverty map rather closely to the rate of excess winter deaths and illnesses across the EU Member States, where rates are highest in countries such as Cyprus, Greece

[10] Utilities include heating, electricity, gas, and refuse collection

and Portugal, and lowest in Scandinavia and Iceland[11], underscoring the close association between cold homes and risks to human health.

Figure 2: Fuel poverty in Europe: consensual indicator 2005-2013 timeline



Energy Poverty, energy vulnerability and energy justice

Some years after energy poverty entered the lexicon, the term 'energy vulnerability' was coined to capture '*the likelihood of a household being able to identify and respond to any significant and/or long term changes in energy prices*'[12]. People should not be considered inherently vulnerable, but rather are placed in vulnerable positions through force of circumstance. Circumstances could, of course, change,

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https://watermark.silverchair.com/fdv184.pdf?token=AQECAHi208BE49Ooan9kkhW_Ercy7Dm3ZL_9Cf3qfKAc485ysgAAAa8wggGrBgkqhkiG9w0BBwagggGcMIIBmAIBADCCAZEGCSqGSIb3DQEHATAeBglghkgBZQMEAS4wEQQMgeMqFd53L7K6-_DQAgEQgIIBYhIGXKKWWHNvdF5Qt7Zz62bxndvvqFacONwvpfdc5X6wO2z0szbEHt13XmEDwkuT5BVHIEGucyq2Vadg6TF2qF-VvmaA4DORCxkpjdw3lTUdYLbXqUDXneu9Q-SfWzFWzJd_TUeRf_KiN25q_vA8nKFlWVHcEztR1qZ3fB_rUk-m2dPs76PeJqosCZUnllha-R4AMBo28xM6CCyEIj08G1Glhae-HVviKaXr4b489DGr54ldyf4Z4rDR40v186StJ3AYNULlZ5KPz3U5NiIJfxA15Ydt_Sbx98hzNOhCs6MJSh9a4lJqSg82tedNH9ic14vpdylxtkxo4L199vPo1dIjeS0yti9n_AolaZ8IZbphJbJKQ4FOllAajzWTNsZk-X9yiL824x8Y8dF3_La0mRrwplUoc2xD1WKnz_5ktR9dGBeE-3v3k4d5OGoEcoTTKcxxKnoHnf6PloM8q6sPvrecWw

12

https://www.cas.org.uk/system/files/publications/taking_the_temperature_review_of_energy_efficiency_and_fuel_poverty_schemes_in_scotland.pdf

meaning that the condition of vulnerability could, and should be addressed and resolved.

'*Studying energy vulnerability means examining risk factors that contribute to the precariousness of particular spaces and groups of people. One novelty of the vulnerability framework is its emphasis on the spatial and temporal dynamics of energy poverty, which recognizes that households described as energy poor may exit the condition in the future by a change in some of their circumstances, and vice versa*.' [13]

Energy Vulnerability

'*To be neither in, nor at risk of, fuel poverty a householder must be able to maintain a comfortable indoor environment; know how to identify and respond to challenges to maintaining that environment; be capable of responding to those challenges; and to perceive themselves as having the capacity and agency to do so*'.

The energy vulnerability lobby campaign to have the alleviation of fuel poverty treated as a matter of social justice, which requires tackling the structural causes of inequality, rather than focusing mainly on technical and economic metrics of housing standards and energy efficiency. Whilst it does not offer a simple guide to how fuel poverty should be defined, it does offer insight into the wider societal impacts of such definitions, and can assist in aligning policy across the multiple areas of economy, poverty, energy, housing, climate change, and fairness. This creation of synergy and coordinated policies comprises perhaps the central theme of fledgling energy poverty strategies at EU Member State level.

As made clear recently in the 2017 Scottish Review of how fuel poverty is defined, there are 3 types of energy justice, which together provide a tool for policy-making, mainly through the investigation of weaknesses and failings of current practice[14]:

- distributional justice concerns the familiar inter-relations of income, energy prices and quality of housing; resolving distributional injustices (such as inability to pay for energy) requires fair *procedures* and *recognition* of different needs of social groups who experience disadvantage;

- procedural justice concerns the means by which people can gain access to energy, including the contesting of injustices, such as through political representation or legal redress;

- recognition justice draws attention to the different amounts of energy likely to be needed to produce the same quality of service for those with limited mobility, or long term ill health, or for families with young children: an energy

[13] http://journals.sagepub.com/doi/abs/10.1177/1420326X17699260

[14] https://www.sciencedirect.com/science/article/pii/S2214629617301202

justice framework would mean that this was recognised and addressed, rather than treated primarily as a matter of ability to pay.

In this way, proponents of an energy justice approach argue for recognition of the *heterogeneity* of those defined as fuel poor, and for participative procedures to decide the means to fairer outcomes. The principle of recognition means that policy makers can become mandated to devise services which are responsive to groups with different needs. By empowering those defined as vulnerable, ensuring greater voice and influence, policy could become more effective in overcoming stigma, challenging preconceptions and prejudices, understanding different needs and making policy fit for purpose.

The energy justice approach thus reframes fuel poverty into broader contexts than public health or energy efficiency, because it distances itself from the quantitative techno-science of traditional approaches. Instead, fuel poverty is interpreted as '*a condition in which a household lacks a socially- and materially-necessitated level of energy services in the home*'[15]. It focuses on the human consequences of energy poverty, interpreting these in the language of inequality, justice, and fairness.

It could be argued that this comprises a radical reformation of how fuel poverty/energy poverty is viewed, moving well beyond the original definition of Boardman (1991), as well as that of Hills (2012).

There is ample scope within a Northern Ireland strategy for a similar reform in terms of how fuel poverty is conceptualised. It could afford new opportunities for innovation and interdepartmental coordination, and would permit greater synergies with how energy poverty is being addressed throughout mainland Europe.

EU policies on vulnerability[16].

As noted in a later Technical Report in this collection, the algorithm developed for AWS3 includes a new parameter, namely vulnerability scores. There is some disagreement at EU level as to what this particular term means, and it is therefore important to make clear what it means in the context of Algorithm 2018.

In EU policies related to fuel poverty, there is no common definition of vulnerability. Each Member State is required to define what they mean by the term. Hence in 2009, the EU gave guidance on how Member States should capture the concept as follows:

[15] http://journals.sagepub.com/doi/abs/10.1068/a38298

[16] I am grateful to my colleague Professor Jan Webb (University of Edinburgh), who co-authored this section. An extended version of it was first published in autumn 2017, by the Review Panel on the Definition of Fuel Poverty in Scotland.

'... each Member State shall define the concept of vulnerable customers which may refer to energy poverty and, inter alia, to the prohibition of disconnection of electricity (gas) to such customers in critical times'.[17]

The guidance treats vulnerability as a by-product of European energy markets, and defines those unable to pay as 'vulnerable customers' who need additional protections. Each EU Member State can then use its own particular definition of the vulnerable customer – there are presently more than a dozen different definitions currently in play. For example, the British energy markets regulator (2013) uses this definition:

'*Ofgem have defined vulnerability as when a consumer's personal circumstances and characteristics combine with aspects of the market to create situations where he or she is:*

- *significantly less able than a typical consumer to protect or represent his or her interests in the energy market; and/or*
- *significantly more likely than a typical consumer to suffer detriment, or that detriment is likely to be more substantial.'*[18]

The Northern Ireland Fuel Poverty Strategy, on the other hand, defines a vulnerable household as *one that contains an elderly person (over 60 years), someone living with a disability or long term illness, or a family with one or more children under 16*[19].

Vulnerable: Variant 1 - Who is vulnerable to being fuel poor?

In Variant 1, the term refers to the types of people or households who are most likely to be in fuel poverty – people or households that are vulnerable to it, in other words. Hence, for example:

'Deprivation is high also among young people and students who regularly live in houses of multiple occupation, but are rarely recognised as a group vulnerable to fuel poverty (Bouzarovski et al., 2013). The same could be said of migrants, homeless people, and asylum seekers.' [20]

Objections have been raised against this use of the term, since it assigns a label or status to people and may imply that this state of risk is immutable, rather than remediable. On the contrary, it is argued, people should be seen as being 'in vulnerable positions', often through no fault of their own:

'*We must recognise that the policies and practices of service and product suppliers in different markets can heavily influence the choices available, the decisions people make and the extent to which people are in vulnerable positions. People, for*

[17] https://www.ceer.eu/documents/104400/-/-/f7cee707-0721-2da3-3275-1d53d5e0db26

[18] https://www.ofgem.gov.uk/about-us/how-we-work/working-consumers/protecting-and-empowering-consumers-vulnerable-situations/consumer-vulnerability-strategy

[19] https://www.communities-ni.gov.uk/sites/default/files/publications/dsd/warmer-healthier-homes.pdf

[20] https://extra.shu.ac.uk/ppp-online/energy-vulnerability-in-multiple-occupancy-housing-a-problem-that-policy-forgot/

example, may 'choose' more expensive energy tariffs, loan or purchase deals because it is the only real option available for them. Similarly people may be put into vulnerable positions because they do not have the confidence – or power – to negotiate affordable deals if they get into debt.'[21]

Vulnerable: Variant 2 - Energy vulnerability in a capabilities framework

Here 'vulnerability' is broadly defined as a lack of the skills and capacities required by households in order to avoid the risks and adverse effects of fuel poverty. A seminal paper published in 2016 by Day, Walker and Simcock[22] states that:

'*Promoting capabilities maximises opportunities, but leaves the individual free to decide what kind of life they value…development programmes should be aiming to increase the capabilities of individuals, and should be evaluated in these terms.*'

The *capabilities* framework has been translated[23] into six contributors to household energy vulnerability, encompassing market access, wider health and social welfare. Each contributor has a subset of metrics that could be used in assessing the severity of national fuel poverty and who is most in need:

- *access* i.e. a household's access to energy markets, including choice and competition amongst suppliers;
- *affordability*, encompassing not only modelled energy costs for particular types of house, but also self-perceived affordability and energy debt;
- *flexibility* i.e. a household's capacity to manage complex local/national energy infrastructures, smart metering and supply contracts and to engage in switching suppliers, tariffs, etc.;
- *energy efficiency*, encompassing not only the customary House Condition Survey data, but also the energy efficiency status of appliances, and self-assessments of the extent to which the building fabric and design supports a household's daily routines;
- *needs*, particularly as these relate to health, other forms of personal vulnerability and thermal comfort;
- *practices*, encompassing energy rationing, self-disconnection, and experienced control over energy use.

Hence, a household which has a required energy cost three times the median, but which is experienced in tariff-switching, finding the best supplier on an annual basis, and has adopted a range of energy-saving routines already has some of the necessary capabilities to reduce the impacts of their high energy costs. By contrast, a household with little or no experience of engaging with suppliers, and only limited

[21] http://www.infohub.moneyadvicetrust.org/content_files/files/tackling_consumer_vulnerability.pdf

[22] https://www.sciencedirect.com/science/article/pii/S0301421516301227

[23] http://journals.sagepub.com/doi/abs/10.1177/1420326X17699260

knowledge of how energy can be saved in their home is more vulnerable to the impacts of fuel poverty. The latter could, it is argued, be deemed in greater need of assistance. Under the current UK definitions (Boardman and the Hills LIHC), none of these factors are taken into consideration when estimating severity of fuel poverty and who is most in need.

Variant 2's emphasis on vulnerability as lack of capabilities strengthens the rationale for widening the types of measures which government schemes deploy in their efforts to alleviate fuel poverty. These go well beyond household heating and insulation measures, and include:

- energy efficiency advice and support;
- installation of innovative energy efficiency devices;
- support for using these;
- support in managing energy debts, understanding bills and switching suppliers/tariffs;
- ongoing help in monitoring energy deals;
- advice on appliance purchasing.

In Northern Ireland particularly, where such services have routinely been provided by experienced District Council teams as part of their fuel poverty outreach programmes, they have been found to maximise both a household's sense of agency and control over their bills, and neighbourhood empowerment[24].

Vulnerable: Variant 3 - fuel poverty's adverse effects on health and wellbeing

Here, vulnerability refers to those individuals who are most susceptible to adverse health effects associated with living in fuel poverty – usually the aged, very young, infirm and disabled. Cold homes are a potential determinant of *future* ill health as well as being an exacerbating factor in current illness and disease. In 2015, NICE published guidance concerned with preventing excess winter deaths and illnesses associated with cold homes in England[25]. This has perhaps the most explicit definition of health-related vulnerability:

> '*A wide range of people are vulnerable to the cold. This is either because of: a medical condition, such as heart disease; a disability that, for instance, stops people moving around to keep warm, or makes them more likely to develop chest infections; or personal circumstances, such as being unable to afford to keep warm enough. In this pathway, the term vulnerable refers to a number of different groups including:*
> - *people with cardiovascular conditions*
> - *people with respiratory conditions (in particular, chronic obstructive pulmonary disease and childhood asthma)*
> - *people with mental health conditions*

[24] https://www.sciencedirect.com/science/article/pii/S2214629617301457

[25] https://www.nice.org.uk/guidance/ng6

https://www.scotphn.net/wp-content/uploads/2016/11/2016_11_02-Addressing-Fuel-Poverty-DPH-Guidance-Final-1.pdf

- *people with disabilities*
- *older people (65 and older)*
- *households with young children (from new-born to school age)*
- *pregnant women*
- *people on a low income*.'

In conclusion, the term vulnerability has been used in many different contexts, and has different meanings in each of them. The EU's directive to Member States, advising them to each construct their own definition of vulnerability in energy markets, has focused on advocacy of additional protections for vulnerable consumers, but has not addressed the wider structural causes of low incomes and relative poverty and resulting needs.

However, where vulnerability is captured within a capabilities framework, it legitimises a range of additional solutions and tools for alleviating fuel poverty, all of which have to do with providing people with the capacities and skills they need to build energy resilience.

Furthermore, where the concept of vulnerability is brought into the context of health, highlighting the extent to which living in fuel poverty can be a factor in causing or worsening disease and ill health, it can be a useful tool for targeting and prioritising scarce resources. It also helps ensure that tackling fuel poverty is not subsumed into a programme for energy efficiency in housing, but retains its significance as a problem in which health impacts stem directly from low income, energy prices, and household energy use. This means that policies to address poverty, social justice and health, as well as housing, are all implicated in solutions.

In these ways, debates about vulnerability have sharpened our understanding of what is means to be fuel poor, and what solutions are likely to be the most appropriate.

Technical Report 2

Approaches to alleviating fuel poverty in Europe

The predominant delivery strategy for alleviating energy poverty in Member States is housing retrofit. The approach is largely technical and focuses on improved energy efficiency in homes. This reflects, in large part, the EU's more general tendency to seek technical solutions to human problems, but also reflects the fact that databases on housing are more advanced and more standardised across Member States than are databases concerned with health, wellbeing, domestic energy costs, or even income.

At a broader European level, an evaluation carried out by the Buildings Performance Institute Europe[26], indicated that:

'…even though energy efficiency measures have proven to be the most sustainable solution to the fuel poverty problem - they receive lower funding compared to income and fuel price support schemes[27]. The Cohesion Policy funds for the periods 2007-2013 and 2014-2020 shows that a significant share - higher than the previous period - of the Cohesion Policy budget 2014-2020 can be used for energy efficiency actions. Therefore, all three Cohesion Policy financial instruments may support the energy renovation of buildings and in particular measures targeting fuel poor and vulnerable consumers. In order to achieve the social, environmental and energy goals set by the EU for 2020, the report recommends the following actions:

- *Higher allocation of EU Funds on renovation programmes targeting vulnerable and fuel poor people;*
- *Implementation of dedicated national programmes addressing the root causes of the fuel poverty problem;*
- *Shifting gradually the price control mechanisms and fuel subsidies to more active and effective public expenditure on renovation measures;*
- *Defining the societal groups that cannot afford sufficient energy to satisfy their basic needs;*
- *Improving statistical data collection to provide additional evidence on the scale and impact of fuel poverty in the EU, in order to have a reliable basis to develop effective policies and support programmes;*
- *Development of a longer-term fuel poverty eradication strategy for the European Union, which should be supported by a predictable and reliable policy framework including an EU-wide energy saving target for 2030.*'

[26] http://bpie.eu/wp-content/uploads/2015/10/Alleviating-fuel-poverty.pdf

[27] http://bpie.eu/wp-content/uploads/2015/10/Alleviating-fuel-poverty.pdf

To date, few peer-reviewed articles systematically compare energy poverty alleviations schemes across Europe. There are at least four reasons for this:

- the absence of any agreed definition of how energy poverty is defined across the EU;
- the lack of any centralised data archive on alleviation schemes and how many households are being assisted;
- the sheer variety of combinations through which measures are delivered across such a large number of member states;
- the greater focus at EU level on vulnerable consumers and how to protect them from issues related to energy injustice – these are not always consumers experiencing energy poverty.

However this situation has improved recently, with the publication of the Energy Poverty Handbook (published by the European Union). This has a comprehensive analysis of schemes across EU Member States[28], and contains more than 30 chapters. A chapter written by a team from University College London, for example, noted that:

- aside from the fact that only four Member States had official definitions of fuel poverty at 2015, some Member States did not recognise the concept of energy poverty at all, viewing it as an indicator of poverty;
- energy poverty is most prevalent in Eastern European Member States, followed closely by Southern Member States;
- in countries such as those of Scandinavia and lower Western Europe, by contrast, the problem is more focal i.e. it is not endemic or country-wide;
- in terms of measures implemented to alleviate energy poverty (the team reviewed 280 measures) 40% were ***targeted***;
- EU-wide approaches have tended to focus on protecting vulnerable customers, and as such have mainly been related to national policies of energy regulation and how these vary;
- other common approaches to alleviating energy poverty have included financial support (in 40% of Member States), energy efficiency programmes (30%), and raising awareness/information provision, which all Member States had some level of investment in.

In a report prepared for the EU Directorate General, Member States are also compared across a range of topics[29], some of which is described below:

[28] http://meszerics.eu/pdf/energypovertyhandbook-online.pdf

[29] http://www.europarl.europa.eu/RegData/etudes/STUD/2017/607350/IPOL_STU(2017)607350_EN.pdf

In France, energy is viewed as a 'basic right'. As a result, energy suppliers cannot cut off energy supply during winter even if customers do not pay their bills. France has two types of means-tested assistance for at-risk households: a lower gas tariff (Tarif Spécial de Solidarité) and a basic necessity tariff which applies to electricity. Over time, these are being replaced with a means-tested energy voucher, which can be used for conventional fuels as well as wood and oil. The voucher can also be used to fund energy-efficiency work in the home, thus providing a more permanent effect.

The *Habiter Mieux programme in* France is part of the energy-efficiency programme that vouchers can be used for. It combines the social objective of eradicating fuel poverty with the environmental need to cut greenhouse gas emissions. It took place primarily in social housing between 2010 and 2017, during which time €1.4 billion was invested from a variety of public budget streams. Energy Efficiency Ambassadors were deployed to locate households most in need, and there was an average reduction in energy use of 37% during the lifetime of the project[30].

Bulgaria is one of the Central Eastern European countries where energy poverty is more prevalent, largely because of the combined drivers of low income and poor housing stock. Lack of national capital has prevented any large-scale rollout of schemes designed to alleviate fuel poverty.

In Greece and Spain, social electricity and energy tariffs have been successful in the short-term, but little has been done to tackle the root causes of fuel poverty. Tariff support has the advantage of low administrative burden, but regulatory pressures on energy suppliers (who had to introduce lower tariffs for vulnerable customers), meant that suppliers themselves have been driven into debt or financial crisis.

Hungary and Germany are among many Member States that have chosen to fund schemes which retrofit homes on a large scale, but these have often invested in homes where people were not in energy poverty. Their focus is on housing regeneration, with alleviation of fuel poverty viewed as a secondary collateral benefit.

Ireland's Warmer Homes Scheme is frequently mentioned as a good practice model for delivering fuel poverty alleviation programmes. It targets energy poor homes. Between 2000 and 2013 over €82 million was distributed through the scheme and more than 95,000 homes were supported. The energy efficiency interventions included measures such as loft insulation, draught proofing, efficient lighting and cavity wall insulation. In 2010, an evaluation of the scheme estimated that implemented measures saved 25 GWh. Among other effects:

- The number of beneficiaries who found it difficult or impossible to pay utility bills on time decreased from 48% to 28%;

- The number of families with children that could keep a comfortable temperature at home increased considerably from only 27% to 71%;

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[30] http://bpie.eu/wp-content/uploads/2015/12/Renovation-in-practice_08.pdf

- The number of beneficiaries who suffered from long-term illness or disorders decreased by 88%;

- Recipients showed significant improvements in other health problems including heart attacks, high blood pressure/hypertension, circulatory problems, problems with joints/arthritis, headaches, and physical and mental disability.

Northern Ireland: A large-scale study in Northern Ireland examined the broader impacts of the region's Neighbourhood Renewal (NR) programme, amongst which were impacts on households in fuel poverty. NR was launched in 2003 and focused on 36 highly deprived areas during a 7-10 year rollout. The effects on fuel poverty were assessed over a 12 year period[31].

Evidence suggested:

- a 3.0% reduction in fuel poverty comparing respondents in renewal areas with the rest of Northern Ireland;

- a 4.7% decline relative to a similarly deprived control group.

The programme was especially effective in relieving fuel poverty among:

- groups with lower qualifications;

- retired households;

- households in receipt of benefits.

As such, it contributed to a reduction in inequalities within the most deprived areas in Northern Ireland and the authors conclude:

'*In terms of the policy implications of this work it is noted that fuel poverty is a particularly obstinate issue in Northern Ireland and has proved difficult to relieve by existing policies which focus on energy efficiency. The findings of this research endorse social and economic renewal policies as a complementary means to strengthen government efforts to tackle fuel poverty. Furthermore, the additional resource, staff and community infrastructure supported by area-based urban regeneration initiatives could act as a conduit for the proactive, area-based approaches to targeting energy efficiency measures by geographic mapping proposed by Walker, Liddell, McKenzie & Morris in 2013. Local regeneration partnership boards and on-the-ground personnel also provide a natural platform for decentralised identification of households at risk of fuel poverty*.'

[31] https://www.sciencedirect.com/science/article/pii/S0301421517308339

Wales: A series of highly regarded studies has recently been published examining the impacts of the Welsh Arbed Scheme (Phase 2), providing details of before and after perceptions and impacts. In one of these, results from 22 focus groups indicated that:

'*improving the energy efficiency of homes at risk of fuel poverty has a profound impact on wellbeing and quality of life, financial stress, thermal comfort, social interactions and indoor space use. However, the process of receiving the intervention was experienced by some as stressful. There is a need for better community engagement and communication to improve the benefits delivered by fuel poverty programmes.*"[32]

In a before-and-after survey of households, the Arbed programme was not associated with improvements in physical or mental health, nor with reductions in self-reported respiratory and asthmatic symptoms. However, the programme was associated with improved subjective wellbeing as well as improvements in a number of psychosocial outcomes, including increased thermal satisfaction, reduced reports of putting up with feeling cold to save heating costs, fewer financial difficulties, and reduced social isolation[33].

England: a cost-benefit analysis of an external wall insulation (EWI) project in Stockton on Tees was based on 2,252 homes. Total benefits were calculated in terms of the differences between the control and treatment groups in fuel costs, health care costs, and the cost of lives saved using the conventional NICE methodology. Total benefits for all households that received EWI were £1,519,045. It was estimated that the full return on the cost of investment would be achieved in less than 8 years[34].

A programme in Wiltshire[35] aimed to create a 'proof of concept' referral system that allowed primary health care practitioners to refer patients for energy support during a GP consultation. It hoped to improve the circumstances and health outcomes of up to 750 patients in fuel poverty. The research team concluded that the project met its goal of recruiting 20 practices but fell a long way short of the goal to refer 750 people for support – just 71 people were referred in total over the course of the project.

Key points from the evaluation findings include:

- There was some evidence of cultural change, with primary care practitioners beginning to understand that they had a role to play in addressing cold homes and fuel poverty;
- Even with small numbers coming through from GP practices, the referral mechanism added value to the fuel poverty outreach services being delivered locally. Staff felt that a high proportion of referrals through primary

[32] http://journals.sagepub.com/doi/pdf/10.1177/1420326X17703450

[33] https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-017-4075-4

[34] https://bmcresnotes.biomedcentral.com/articles/10.1186/s13104-017-3067-x

[35] http://shura.shu.ac.uk/17293/1/eval-royal-college-gps-fuel-poverty-pilot.pdf

care would not have been made through other referral routes if the primary care pilot had not been operating;

- Practices which were successful in making referrals all had a member of practice staff acting as a champion for the project, usually a practice manager;

- Where practices had sought to engage and convince their staff of the benefits, nurses and Care Coordinators were particularly effective sources of referrals;

- Despite often being willing to engage with the pilot, GPs regularly felt unable to find the time to raise the issue of cold homes with patients.

This is the latest in a relatively large number of research studies to indicate ***potential*** rather than ***success*** in delivering GP-led referrals into fuel poverty alleviation programmes.

A before-and-after survey of 228 households living in social housing in Northeast England was carried out as part of the Gentoo programme. The average intervention cost £3,725. At 12-month post-intervention, a 16% reduction (−£94.79) in household 6-month health service use was found. Statistically significant positive improvements were observed in:

- main tenant and household health status;

- main tenant satisfaction with financial situation;

- number of rooms left unheated per household;

- frequency of household outpatient appointments;

- accident/emergency department attendance.

These changes were most often observed among older households[36].

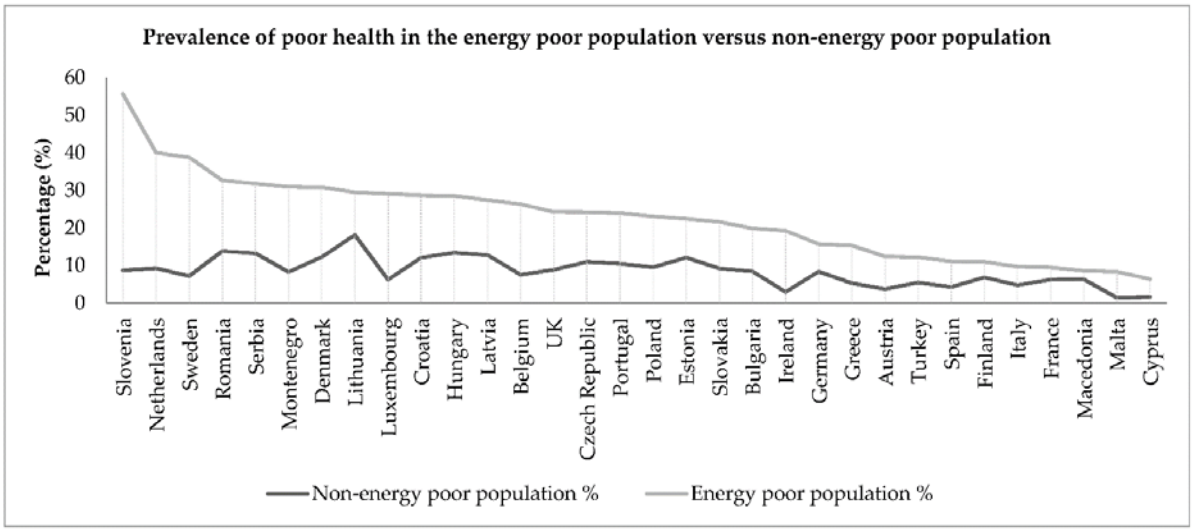
These studies, all published within the past year, appear to show considerable justification for investing in fuel poverty alleviation schemes, as a means of protecting human health and wellbeing, as well as a vehicle for reducing health and social inequalities.

[36] https://link.springer.com/article/10.1007/s00038-017-0989-y

Impacts of living in energy poverty – a Europe wide analysis

A comparison of 32 European countries compared mental wellbeing and how it correlates with people's energy poverty status. Figure 3 illustrates the extent of self-reported health disparities depending on whether people are in energy poverty or not. Disparities are particularly prevalent for Slovenia, Netherlands and Sweden, where people in energy poverty are particularly likely to rate their health as poor. In 20 of 32 countries, the association between poor physical health and energy poverty was found to be statistically significant.

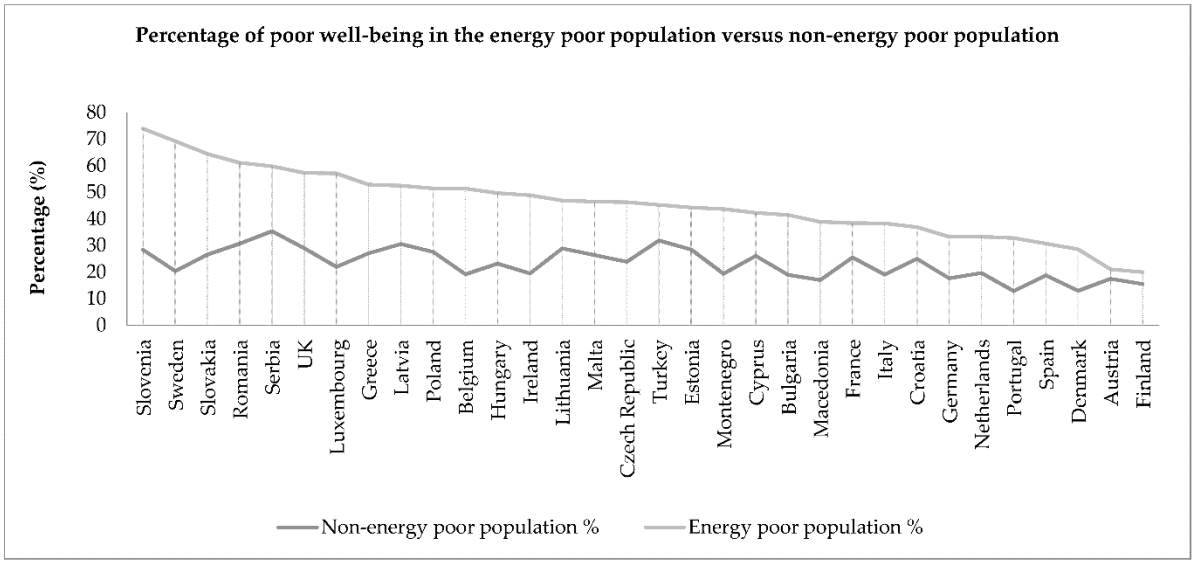
Figure 3: Poor health – a comparison of people *in/not in* energy poverty



With regard to mental wellbeing, Figure 4 illustrates a similar pattern. Slovenia and Sweden feature again as countries with high disparities depending on whether people are in energy poverty or not. Of the 32 countries that were compared, statistically significant associations between poor mental health and energy poverty were found in 25[37].

[37] http://www.mdpi.com/1660-4601/14/6/584

Figure 4: Mental wellbeing – a comparison of people *in/not in* energy poverty



More generally, it has been found that mental health and wellbeing are significantly more responsive to improvements in energy efficiency, with effects seeming to be almost immediate. Improved thermal comfort, more affordable energy bills, and an enhanced sense of control all seem to be implicated in this therapeutic effect.

Technical report 3

Advances in 'smart' technology and billing, and their potential for alleviating fuel poverty

The prospect of an EU-wide smart metering rollout is being driven by the European Union (EU), whose IME3 or Third Energy Package includes 2 key Directives that pertain to smart metering in Member States. These are Directives 2009/72/EC and 2009/73/EC, which provide Member States with guidance on how to develop an evidence-based decision concerning the implementation of a smart metering programme. The requirements in the electricity and gas directive are slightly different and are set out below.

Annex 1 (2) of the Electricity Directive states:

'Member states shall ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the electricity supply market. The implementation of those metering systems may be subject to an economic assessment of all the long term costs and benefits to the market and the individual consumer or which form of intelligent metering is economically reasonable and cost-effective and which timeframe is feasible for their distribution.

Subject to that assessment, Member States or any competent authority they designate shall prepare a timetable with a target of up to 10 years for the implementation of intelligent metering systems. Where roll-out of smart meters is assessed positively, at least 80% of consumers shall be equipped with intelligent metering systems by 2020.'

Annex 1(2) of the Gas Directive states:

'Member states shall ensure the implementation of intelligent metering systems that shall assist the active participation of consumers in the gas supply market. The implementation of those metering systems may be subject to an economic assessment of all the long-term costs and benefits to the market and the individual consumer or which form of intelligent metering is economically reasonable and cost-effective and which timeframe is feasible for their distribution.'

Both of these assessments had to take place by September 2012.

Subject to the assessments, Member States or any competent authority they designate, were expected to prepare a timetable for the implementation of intelligent metering systems. In other words, the outcomes of an economic assessment permit Member States some level of choice on rollout, but these choices are required to be *wholly* dependent on the outcomes of their economic assessment. Hence:

- If the economic assessment for both gas and electricity suggests positive benefits : costs ratios, EU Member States should participate fully in a smart metering implementation plan in accordance with the EU Directive i.e. an

80% by 2020 scenario for electricity meters with a more flexible plan for gas meters;

- Should one scenario (gas, electricity, or gas-and-electricity) yield a positive outcome, but the others a negative or inconclusive outcome, then implementation should take place for the positive outcome;

- Should all three options return negative or inconclusive outcomes, Member States are encouraged to develop an implementation plan of their own choice and design, commensurate with other aspects of their sustainable energy plans.

Customers are expected to be the primary beneficiaries from smart meter rollout in the Member States. Customers lever in these savings through reducing their energy consumption as a result of real-time feedback. They are expected to reduce their consumption by between 0% and 5% (estimates depend on the Member State calculating the impacts).

Customer engagement and education is viewed as important, although little real investment has – as yet – been made in maximising customer support for smart metering.

In 30% of Member States, a positive business case was not achieved, and in still others, inconclusive business cases resulted in decisions against rollout.

NI's two nearest neighbours (GB and Ireland) each published CBAs – they differed markedly from those of most other Member States. In both, benefits appear to be modelled at higher than average levels. In Ireland costs are also higher than for any other Member State. Both jurisdictions returned cost-benefit analyses that were positive for gas, triggering rollout of smart gas metering; only the UK returned a cost-benefit analysis that was positive for electricity – thereby triggering a dual meter rollout.

As noted by Pullinger and colleagues in 2014, there is now substantial evidence that customer savings from smart metering come about through pricing pressures; these pressures derive mainly from time of use (TOU) tariffs which make the use of gas and (especially) electricity significantly more expensive at certain times of day. By shifting usage to cheaper times of day, customers are able to reduce their energy bills. This is estimated to be the source of 40% of customer changes in consumption; the remainder comes from the other source of lower energy bills, namely lower consumption of energy through changes in behaviour. Since it delivers more than half of customer savings, there is substantial potential to reduce environmental impacts through behaviour change."[38]

Recent smart metering studies have compared smart meter installation on its own, with an accompanying in-house display (IHD), and the same service with energy efficiency advice. These are all trials selected for their scientific rigour and relevance to Northern Ireland. That is, they:

- are relatively large-scale;

[38] Pullinger et al., (2014)

- use trial groups of at least 200 households;
- were carried out in real-life conditions and not with volunteers;
- were mostly carried out in cool temperate climates.

These studies showed that a smart meter accompanied by a support programme can reduce electricity consumption by between 1% and 9.1%. Without support, reductions are consistently lower and range from a 1.1% increase in consumption to a 4% reduction.

For gas consumption, supported smart meter rollout can reduce consumption by between 1.2 and 4%, compared with 1.5% and 3% without support.

It is important to consider at this stage whether these estimates – based on studies carried out in regions beyond Northern Ireland - require attenuating in order to reflect the local conditions that prevail in NI. At EU level, trials certainly indicated the vital importance of considering the local energy contexts of each Member State before making estimates of impacts.

Here, a first consideration is the prevalence of prepayment meters (PPMs) in Northern Ireland. PPM customers may already have made significant reductions in electricity use, particularly because many PPMs are installed with a Freedom Unit which provides customers with feedback features similar to those on a smart meter's inhouse display. Around half of all NI customers currently have a prepayment meter, and (unlike in most other parts of the world), their use is not confined to customers with a history of debt. Evidence on switching suppliers also indicates that PPM customers are more likely to switch,[39] indicating greater price sensitivity, and further strengthening the assumption that PPM customers will already have levered in substantial savings on their bills through their own monitoring and behaviours

Furthermore, a small proportion of electricity customers in NI are already on TOU tariffs (e.g. Powershift customers with PowerNI), which will have made further inroads into the potential savings from smart meter installation.

With specific reference to customers in fuel poverty, there is strong evidence of inelasticity in energy consumption – which means that customers who cannot afford a decent standard of energy use are most likely to pare use down to an absolute minimum. The 2012 trial of smart metering in Northern Ireland demonstrated this very clearly, as can be seen on Figure 5, which compares a year's electricity consumption for three groups:

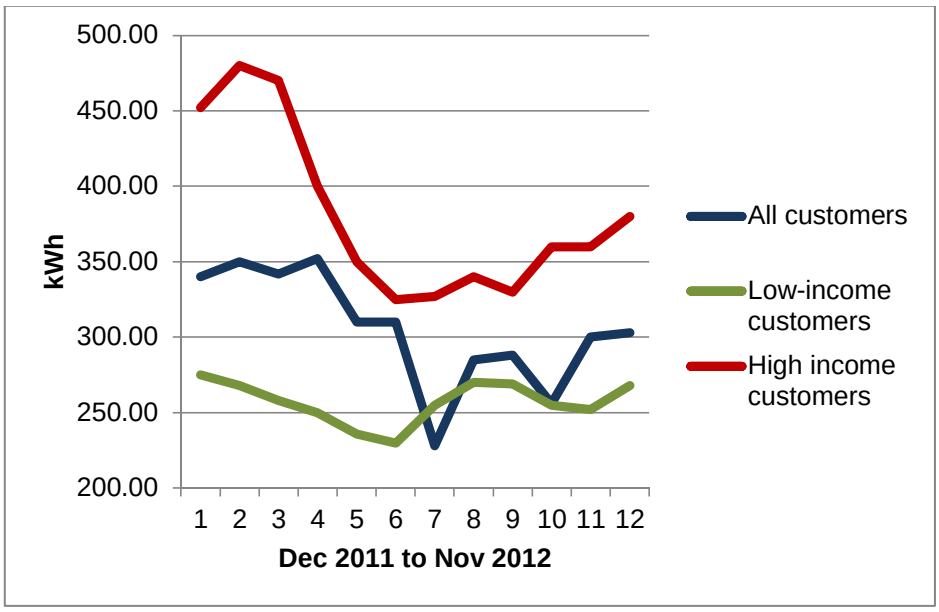
- average customers in NI;
- high consumers in the trial;
- low consumers in the trial.

Not only were low consumers paring their electricity usage to a minimum, they showed virtually none of the seasonal fluctuations that were evident in the annual profiles of the other two groups. It is unlikely that customers who have already flattened their electricity use will save significantly as a result of having a smart

[39] UREGNI (2014). Annual Energy Retail Report

meter. With more than 40% of NI households estimated to be in fuel poverty, the dampening effect of inelascticity is likely to be a significant limiter on potential impacts of any smart meter rollout.

Figure 5: Monthly electricity consumption in Northern Ireland – consumption profile for all, low-income, and high-income customers[40]



At a broader UK level, NEA, Consumer Focus (now Citizens Advice) and Age UK have all been prominent in smart meter advocacy for people in fuel poverty. They argue for third party support around the time of installation for several groups, including those experiencing fuel poverty. Smart Energy GB (a government-appointed organisation which advises on customer support) has recognised the need for particular recognition of these groups, noting a relative lack of interest in technology among vulnerable groups.[41] Their Consumer Engagement Plan points to the need to integrate support for vulnerable customers, and selects three groups for special attention: prepayment customers, renters and those in fuel poverty.

A frequently noted issue regarding fuel poor customers is that of self-disconnection which happens more frequently among the fuel poor than any other customer segment. The adverse health and wellbeing impacts of this have been extensively researched in New Zealand, and many findings are applicable to the UK.[42] Self-disconnection patterns (particularly when these are frequent, usually take place at the same time of day, and occur more often in colder weather) are signals of

[40] Data provided by PowerNI, Northern Ireland's largest supplier of electricity to domestic customers

[41] BS Consulting, NEA and Consumer Focus (2012) *Smart for All. Understanding consumer vulnerability during the experience of smart meter installation.* NEA, Newcastle upon Tyne; Smart Meter Central Delivery Body (2013) *Engagement plan for smart meter roll-out*.

[42] O'Sullivan K, Howden-Chapman P, Fougere GM, Hales S and Stanldy J (20130) Empowered? Examining self-disconnection in a postal survey of electricity prepayment meter consumers in New Zealand. *Energy Policy* **52**, 277-287

energy being unaffordable, and therefore of vulnerability. Crucially, smart meter data can help with diagnosis of fuel poverty (via self-disconnection data) and with identifying solutions, but this does require the institutional support which can offer effective advice and follow up.

Taken together there could still be reasonable scope for reducing NI's electricity consumption during a smart meter rollout, at a level approximating what has been estimated for neighbouring jurisdictions. But this will likely require sustained customer support and engagement, without which it would be unreasonable to believe that NI customers will be able to save the same as has been modelled for Ireland in their cost-benefit analyses for smart meter rollout, or even the more modest amounts estimated for GB. Lower incomes, the prevalence of fuel poverty, and the deep penetration of PPMs, will offset any modest potential for saving. However, smart metering provides half-hourly downloads of energy consumption for any household which has one, and the potential of these data for identifying households most likely to be in extreme fuel poverty is immense via usage patterns characterised by:

- inelasticity of consumption;
- low seasonal variation in consumption;
- frequent intervals of self-disconnection.

Finding many of those most in need of assistance from an AWS scheme could be both efficiently and cheaply achieved through an algorithm which analyses consumption data alone.

At last assessment, it was still somewhat unclear whether Northern Ireland should be considered a separate region from GB, in which case a separate cost-benefit analysis for the region would have to be undertaken. Whilst at least two CBA studies were commissioned by then DETI, neither were placed in the public domain, and both are now outdated. A recent GB decision to extend their smart meter rollout timeframe by 5 years (because of spiralling costs, among other issues), has perhaps pushed the issue of a separate NI-specific CBA down the agenda, at least for the time being.

Technical Report 4

Targeting those most in need: the 2018 algorithm

In a recent analysis of area-based targeting in Oberhausen, Germany[43], it is noted that:

'*A well-targeted energy poverty programme is defined as one that reaches a high proportion of the target group whilst minimizing the number of recipients who do not fall into the target group. Talking about the mismatching of target groups means talking about inclusion and exclusion. The former refers to households that are determined as being eligible for subsidies although they are not actually fuel poor (not part of the original target group); the latter refers to households that actually struggle with fuel poverty but are excluded from state support due to the eligibility criteria. Evaluation of British fuel poverty programmes highlight the phenomenon of wrongful inclusion and exclusion'.*

As the analysis also points out:

'*The idea behind area-based approaches is that small spatial units are relatively homogenous in terms of building and household characteristics. Consequently, these approaches do not measure fuel poverty at an individual level, but at a spatial unit level. They identify neighbourhoods, streets, blocks of flats etc. that show a high vulnerability to fuel poverty according to their building and household characteristics. The appeal of this kind of approach is that it does not use primary data (e.g. income, energy expenditure etc.) to identify fuel poor neighbourhoods, but instead uses supporting indicators (e.g. age, household size, building type etc.). This data is locally available and aggregation at spatial unit level avoids data security restrictions. Moreover, these indicators enhance the picture of fuel poverty and help provide a focus for policy actions, as they measure criteria that contribute to fuel poverty without measuring fuel poverty itself. The challenge is to select the proxy indicators that best reflect the vulnerability to fuel poverty and to aggregate the data to an index to minimise inclusion and exclusion effects. Walker, Liddell, McKenzie & Morris have demonstrated the practicability and effectiveness of such an approach. They designed a spatial unit level index for Northern Ireland and checked the results via door-to-door interviews in some of the identified spatial units: the results showed that in the spatial units identified as having a high fuel poverty risk in the FPI, up to 90% of the households were actually fuel poor*.'

The German study was successful in highlighting areas of greatest need. Each geographical unit contained more than 1,000 households. As will be seen later in this section, the Northern Ireland algorithm referred to in the above quote is able to achieve a more granular level of targeting, namely at Small Area level (averaging 155 households).

[43] https://ac.els-cdn.com/S1364032117310651/1-s2.0-S1364032117310651-main.pdf?_tid=c524be9f-1124-4020-9aa2-b2eed9435978&acdnat=1520591446_aabd509e5955f5cf53976474bea67c2a

Brief introduction to statistical geography

The smallest geographical unit at which demographic, health, and other statistics are available in the UK is the **small area**. The average size of a small area in Northern Ireland is:

- 400 people;
- or 155 households, although the range is large (from 59 to 988)[44].

The physical size of small areas varies greatly: they can be very small in densely populated urban areas, and many hundreds of square metres in remote and sparsely populated rural areas. Where possible they have regular shapes and follow existing features (i.e. roads, rivers, fence lines etc.). However, they do not necessarily have "intelligent" borders, in that they may end half way along a road, or include only households on one side of a road.

Table 1 provides details of the levels of geography used in Northern Ireland, and compares this with England and Wales.

Table 1: Levels of geography in NI[44], England and Wales[45].

Level	Number of units	Average Households (NI)	Average Population (NI)	Average Households (England & Wales)
Local Government Districts	11	70,103	169,285	
Wards	582	1,100	3,000	2,726
Super Output Areas	890	700	2,000	672
Small Areas	4537	155	400	129

Levels of geography in Scotland are harder to compare. In 2011 there were:

- 46,351 Output Areas;
- with an average of 114 people per Output Area;
- and 51 households per Output Area.

Broadly speaking, this means that a Scottish Output Area is an even more granular unit of geography than applies elsewhere in the UK.

[44] http://www.ninis2.nisra.gov.uk/public/documents/NISRA%20Geography%20Fact%20Sheet.pdf

[45] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/2011censuspopulationandhouseholdestimatesforsmallareasinenglandandwales/2012-11-23

Statistical geography, fuel poverty and regional approaches to identifying those most in need

Until recent times throughout the UK, a common approach to identifying households most in need of assistance in tackling fuel poverty was to *categorise need into manageable bands.* Three bands were defined, namely *in fuel poverty*, in *severe fuel poverty*, and in *extreme fuel poverty*. Priority could then (ideally) be given to those in severe or extreme fuel poverty. However, over the past 3 years, UK regions have diverged considerably in their approaches to defining priority groups for assistance.

England: England adopted the Hills LIHC definition of fuel poverty[46] in 2012, and no longer calculates traditional bands of severity/need. Instead, the Hills definition yields a numerical score known as the "*fuel poverty gap*". This gap reflects how much more than the median spend a household (HH) needs in order to achieve an internationally recognised standard of warmth and sufficient energy for appliances and lighting. It is a fully sliding scale rather than a set of crude bands. For example, one house could need £6 more per annum than the English median, another could need £179 more.

Currently, the Hills approach provides government with the England-wide gap on an annual basis, and the aspiration is that the gap will reduce year on year rather than expand, assuming fuel poverty is being addressed effectively. At this stage, the gap is generally cited as a single aggregate value for England, which is published annually. The gap has not as yet been used to identify small areas where the highest fuel poverty shortfalls are clustered.

However, several targeting tools have been developed in recent years[47]. Almost all of these are capable of deployment in relatively large geographical areas, the smallest of which are Lower Super Output Areas (LSOA's) – these consist of between 1,000 and 3,000 households[48]. Estimates at this level are "validated", although the level of validation appears to be weak, since it consists of:

'*ensuring that the output area fuel poverty percentages are within a sensible range and that the regional totals are achieved at each level of aggregation. Results are also compared to the previous year's figures to check for consistency*'[49].

[46] LIHC = Low Income High Cost

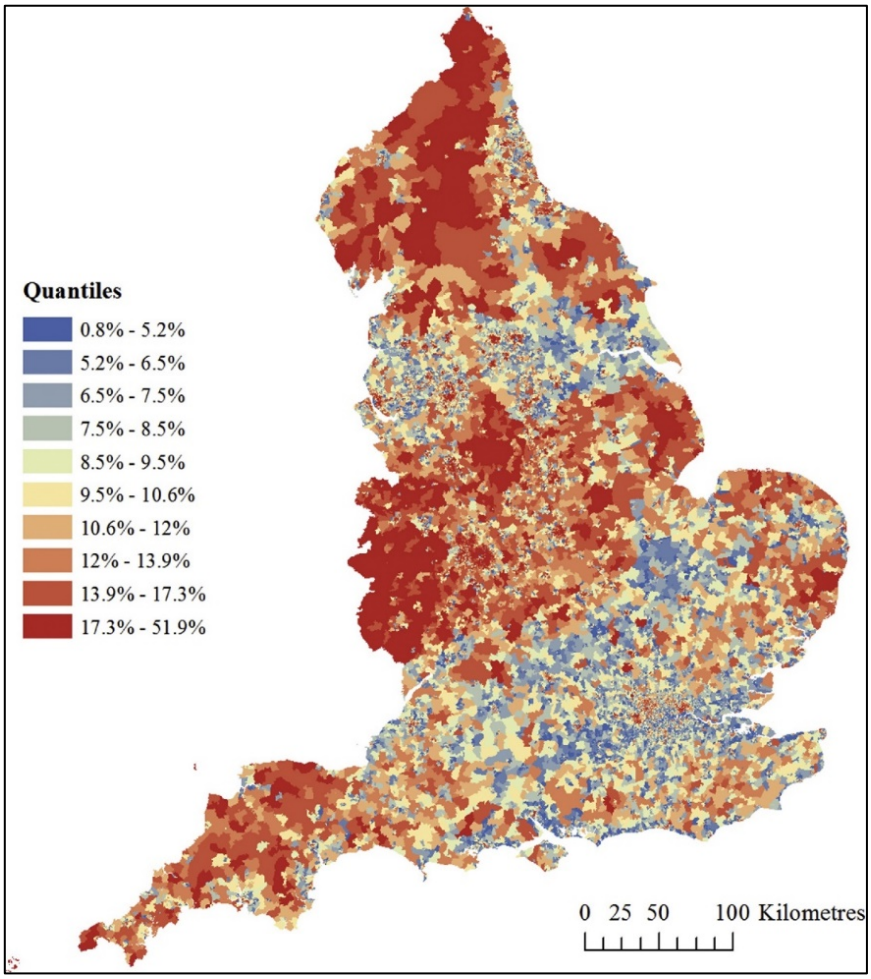
[47] e.g. https://parallel.co.uk/3D/fuel-poverty/#12/52.4924/-1.9746/0/60

[48] https://www.sciencedirect.com/science/article/pii/S2214629617303195

[49] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/533073/Fuel_poverty_sub_regional_methodology_2016.pdf

Figure 6 illustrates how fuel poverty is distributed across England at LSOA level. To date, this approach to targeting funds and support has not been deployed systematically at national level, although the intention at the Department for Business, Energy and Industrial Strategy intends to do so in the medium-term[50].

Figure 6: Relative percentage of fuel poor households using LIHC indicator at LSOA level [48].



In the mean time, local authorities interested in targeting households most in need have generally adopted their own systems for targeting, as have energy companies delivering their ECO obligations. Sometimes targeting has been based on an organisation's own criteria and in-house teams (e.g. the Greater London Authority's Intelligence Team's targeting tool for London)[51]. At other times targeting maps have been commissioned from expert agencies, such as Durham Council's BRE[52]-based

[50] Ibid.

[51] https://www.london.gov.uk/sites/default/files/gla_migrate_files_destination/Fuel%20poverty%20-%20Final%20report.pdf

[52] Building Research Establishment

tool, which uses HHSRS[53] data and a health risk database[54], and Southend-on-Sea District Council's targeting strategy, which was developed using the Energy Savings Trust's expertise[55].

There remains considerable caution around the robustness of targeting even in the larger geographical areas, as indicated in this recent (2016) statement from BEIS:

'In 2013, DECC undertook an internal review of the methodology used to produce sub-regional estimates of fuel poverty, in conjunction with ONS Methodology Advisory Service. This review found that estimates of fuel poverty were robust at local authority level, but not robust at lower levels of geography. In particular, estimates of fuel poverty at Lower Super Output Area (LSOA) should be treated with caution. The estimates should only be used to look at general trends and identify areas of particularly high or low fuel poverty. They should not be used to identify trends over time within an LSOA, or to compare LSOA's with similar fuel poverty levels due to very small sample sizes and consequent instability in estimates at this level. We are continuing to develop our modelling of sub-regional fuel poverty, including providing estimates of the precision of these statistics, and plan to publish more information on this in the future"[56].

England's Committee on Fuel Poverty is an advisory Non-Departmental Public Body sponsored by the Department of Business, Energy and Industrial Strategy. The Committee published its first Annual Report in Sept 2016, and concluded that:

"*It is difficult to overstate the importance of being able to identify the location of each individual household in fuel poverty so that assistance can be targeted effectively to them.*"

The Committee listed a dozen recommendations for policy, one of which was the development of a:

"*...targeting efficiency metric which should be deployed for each Government programme in the Fuel Poverty Delivery Scorecard to track the progress of targeting efficiency on those in fuel poverty*"[57].

These statements from the Committee seem to indicate that, in their opinion, targeting fuel poverty assistance to those most in need in England is deemed to be crucial, but remains prominent more in the breach than in the delivery.

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[53] Housing Health and Safety Rating System

[54] http://www.durham.gov.uk/media/1057/Home-energy-conservation-act-report-2015/pdf/HomeEnergyConservationActReport.pdf

[55] http://www.energysavingtrust.org.uk/blog/housing-data-key-tackling-fuel-poverty-southend-sea

[56] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/533056/Fuel_poverty_Sub-regional_report_2016.pdf

[57] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/553931/CFP_report_-final.pdfhttps://www.gov.uk/government/uploads/system/uploads/attachment_data/file/553931/CFP_report_-final.pdf

Most recently, BEIS has published a report on developing a new targeting tool based on machine learning[58]. This involves training an algorithm to identify fuel poor households based on data from sources such as the NEED database (National Energy Efficiency Data-framework), Ordnance Survey, House Condition Survey, and Energy Performance Certificate database. It is a technique commonly used where data are sparse or incomplete, or where only some of the key parameters have been measured (for example in face recognition or medical diagnosis).

This too is able to operate only at LSOA level and above, largely because of access constraints for one of the datasets (DWP data on benefit claimants). Outcomes of piloting the model were as follows: when predicting whether a household would be fuel poor or not, over 1/3 of nearly 2,700 predictions were incorrect. Since the decision was a binary one, the improvement over a purely random guess for each household (50% incorrect) was modest. In most cases, errors were in the form of false positives – since false positives will require further scoping of a household by energy efficiency agencies, this significantly reduces the cost-effectiveness of the approach.

Broadly speaking, deployment of area-based targeting in England remains diverse and fragmented, with no comparison of the efficacy of one approach over another. Furthermore, where forms of targeting have been deployed, these operate only in relatively large-scale areas where the risk of areas containing many non-eligible household's is high.

Wales and Scotland: these regions, in contrast to England, retain the Boardman definition of fuel poverty, and along with that, a 3-way split in severity of fuel poverty. Here the categories are:

- **10-15%** needs to spend = a household is in fuel poverty;
- **15-20%** needs to spend = a household is in severe fuel poverty;
- **20% or more** needs to spend = a household is in extreme fuel poverty.

Wales: Wales has explored area-based approaches to addressing fuel poverty in both of their current flagship fuel poverty programmes, namely Nest and Arbed. However, very little formal analysis has been completed on developing a small area mapping system beyond estimates of fuel poverty prevalence in three geographical regions. These are Mid, North, and South Wales, where prevalence estimates provided by BRE are cited as 28%, 23% and 50% respectively[59]

[58] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/633228/need-framework-annex-a-fuel-poverty-targeting.pdf

[59] http://www.assembly.wales/Research%20Documents/Fuel%20Poverty%20-%20Quick%20guide-15022011-210270/qg11-0002-English.pdf

Mapping for the Nest programme has been largely confined to identifying rural areas in greatest need[60]. In a 2016 Consultation Document the following is headlined (bold print as it appears in the Consultation Document):

"The Welsh Government has limited powers to tackle low income and energy prices, making the eradication of fuel poverty a real challenge. ***However, it can make a real difference by improving the energy efficiency of homes in Wales with resources targeted at those households most in need of support"***[61].

However, even these loosely defined targeting goals for Nest have not been consistently adhered to, since energy efficiency measures in Wales are still installed predominantly in urban homes:

'*There is evidence to suggest that in spite of its rural acknowledgement, activity remains primarily within urban areas, with rural householders not benefitting from the scheme to the same degree as their urban counterparts. The Nest annual report which details the breakdown by urban and rural classification of customers receiving a home energy improvement package, shows that in the first year of the scheme (April 2011-March 2012) the vast majority of customers (79%) receiving installations via Nest were located in urban areas. The second year of Nest (April 2012 – March 2013) demonstrated some improvement; whilst the majority of householders (62%) were located in urban areas, those located in rural areas accounted for (38%) – an increase of 17% on the previous year*'[62].

This suggests that there has been relatively light pressure on Welsh local authorities, energy suppliers, and community groups to focus on areas designated as being most in need. In 2016, the Welsh Government concluded:

"*Nest is a successful scheme and Welsh Government wants to build on that success. However, there is evidence that changes to the existing scheme could further improve the targeting of and support for households most in need and most at risk from living in a cold home*"[63].

To evaluate Nest's targeting performance - one from Bristol's Centre for Sustainable Energy (CSE), the second from Miller Research (UK). These provide detailed information on:

- which low income people would gain a significant reduction in vulnerability through home energy efficiency improvements;
- the options for targeting these people / groups effectively;

[60] http://www.senedd.assembly.wales/documents/s28596/EEFP%2019%20Calor%20Gas.pdf

[61] https://consultations.gov.wales/sites/default/files/consultation_doc_files/160810-a-future-demand-led-fuel-poverty-scheme-to-succeed-warm-homes-nest-en.pdf

[62] http://www.senedd.assembly.wales/documents/s28596/EEFP%2019%20Calor%20Gas.pdf

[63] https://consultations.gov.wales/sites/default/files/consultation_doc_files/160810-a-future-demand-led-fuel-poverty-scheme-to-succeed-warm-homes-nest-en.pdf

- which groups of people might benefit from a scheme under different budget scenarios.

These reports are presently being scrutinised with a view to '*informing prioritisation, value for money decisions, and the setting of eligibility criteria*'[64]. It should be noted, however, that Nest is a demand-led programme in which customers refer themselves into the scheme, which of itself makes area-based targeting of any kind particularly difficult.

The other flagship programme in Wales, Arbed, is more concerned with social housing and properties owned by registered private landlords. It has had more success in confining its activity to area-based principles based on need, since it relies much less on self-referral. "Need" is defined using criteria such as deprivation, benefit take up, off-gas location, solid wall predominance, private rental prominence, and whether the area is a strategic regeneration area, renewal area or Communities First area. Arbed is currently set for a £55M expansion delivered over three years.

In sum, Arbed has delivered a more targeted approach than Nest, but neither scheme is based on a region-wide system for targeting using agreed and consistent criteria which can effectively predict levels of need.

Scotland: Although the smallest level of geography in Scotland is the Output Area (containing an average of 51 households), the smallest level of statistical geography used to find Scottish households most likely to be in fuel poverty is not at Output Area level, but rather at Intermediate Zone level. In Scotland, an Intermediate Zone contains an average of approximately 1,900 households. Hence Scotland's area-based methodology uses a scale more than 10 times larger than that used in Northern Ireland.

At intermediate zone level, estimates in Scotland remain uncertain:

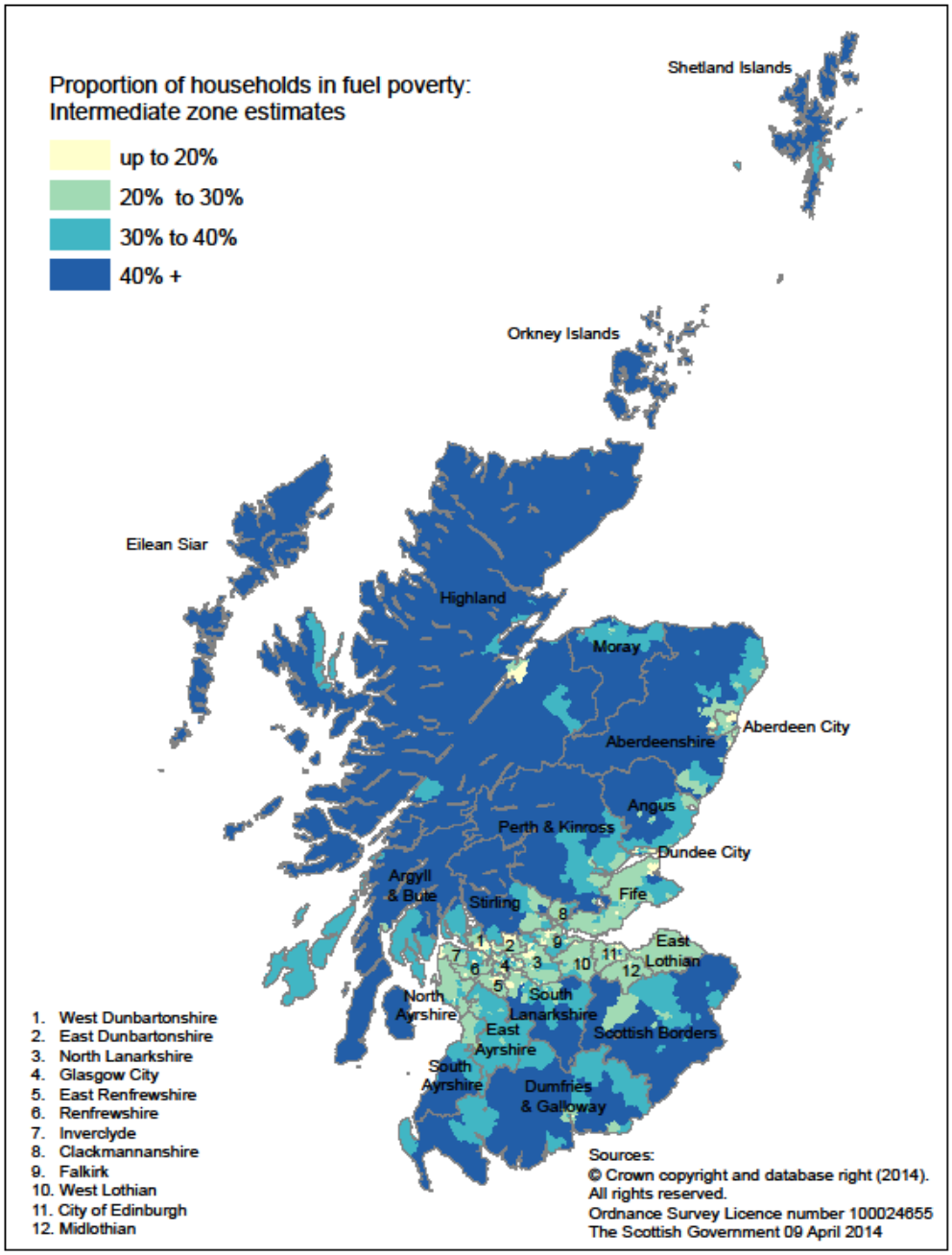
"*While the model performs well against standard statistical tests, in many cases the resulting estimates are technically not distinguishable across geographic areas with similar levels of fuel poverty, i.e. the differences are within the margin of error. For this reason we are providing the outputs from the model as broad general categories, describing fuel poverty as low (fewer than 20% of the households are fuel poor), medium (between 20 and 29% fuel poor households), high (between 30 and 39% of households fuel poor) and very high (40% or more fuel poor households), rather than in terms of exact numerical values. Hence, despite the acceptable precision, there is little distinguishability amongst the intermediate zone estimates apart from the small number of areas with very high (40%+) estimate of fuel poverty. The reason is that the great majority of intermediate zones are estimated to have fuel poverty rates from just under 20% to just over 30%. With confidence intervals approximating 10 percentage points either way it is impossible to say such areas have significantly different fuel poverty rates"*[65].

[64] Ibid.

[65] http://www.gov.scot/Topics/Statistics/SHCS/Downloads/LIFP-2014

The limitations of mapping at Intermediate Zone level is particularly evident when this approach is used to map fuel poverty in relatively small regions within Scotland. Figure 7 illustrates how fuel poverty in Highland and Island regions emerge from Intermediate Zone level algorithms.

Figure 7: Scotland: Fuel poverty severity levels at intermediate zone level[66]



[66] https://gss.civilservice.gov.uk/wp-content/uploads/2014/09/Final-report-on-developing-small-area-estimates-of-fuel-poverty-in-Scotland.pdf

The Scottish ONS team which carried out this research concluded that:

"*Due to estimates being alike over a large number of Intermediate Zones though, the precision measures are not sufficiently good for high discrimination....While the model performs well against standard statistical test, in many cases the resulting estimates are technically not distinguishable across geographic areas with similar levels of fuel poverty, i.e. the differences are within the margin of error*[67]"

Plans are currently being evaluated for focusing new funding in areas where over 40% of households are likely to be in fuel poverty. By contrast, the NI Validation Pilot was able to target areas where 89% of households were shown to be in fuel poverty.

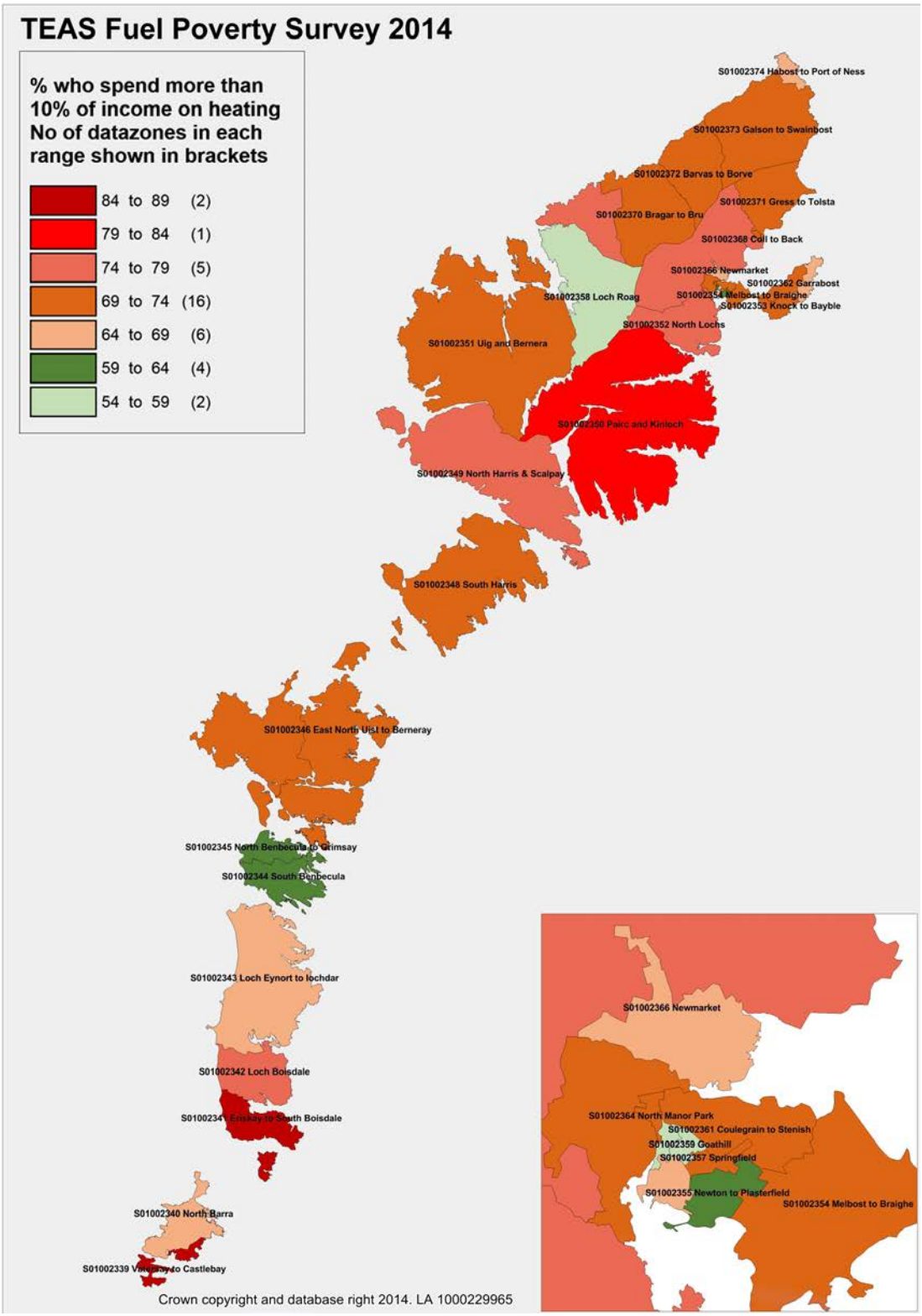
A rather different approach to identifying geographical areas in need has been piloted in Eileanan Siar[68], using respondents to a household fuel poverty survey. An example can be seen in Figure 8. The map was generated from 2,167 households who responded to a comprehensive survey from which severity of fuel poverty could be quite fairly reliably estimated.

However, being based on self-report rather than Census or House Condition Survey data, this approach moves beyond the conventional constraints of an objective assessment of fuel poverty severity. Nevertheless, it is based on data from 20% of all households living on Eileanan Siar; when compared with House Condition Survey data for the islands, this represents a sample size ten times that used to estimate fuel poverty in the islands during the latest House Condition Survey.

[67] http://www.gov.scot/Topics/Statistics/SHCS/Downloads/LIFP-2014

[68] Western Isles, Scotland

Figure 8: Eileanan Siar: fuel poverty severity map[69]



[69] http://tighean.co.uk/downloads/Fuel%20Poverty%20Report%202014_Email-Layout.pdf

Northern Ireland's targeting algorithms AWS2 and AWS3: In the Fuel Poverty Review launched by DSDNI in 2011, four bands of fuel poverty were used. This diverged from the bands used by England, Wales and Scotland, who deployed a three bands structure[70].

The rationale for this was based on the fact that NI's extremities of FP were greater than those prevailing in any of the other UK regions. The Review recommended the following bands:

- **10-15%** needs to spend = in fuel poverty;
- **15-20%** needs to spend = severe fuel poverty;
- **20-25%** needs to spend = extreme fuel poverty;
- **over 25%** needs to spend = very extreme fuel poverty.

At the time the Review was launched, there were an estimated 33,499 households in *very extreme fuel poverty* using the proposed 4-band structure, and these were identified as being the target group for prioritisation in addressing fuel poverty.

The outcomes from all of NI's fuel poverty algorithms (AWS1, AWS2, and now also AWS3) resemble the fuel poverty gap metric that Hills developed for England in that it provides a rank order of need which is a fully sliding scale. In AWS2, for example, need scores ranged:

- **from 23.06** - the Small Area whose features mean the cluster has the lowest likely eligibility for assistance from AWS2;
- **to 65.02**- the Small Area which has the highest likelihood of needing assistance from AWS2.

Summary of targeting tools deployed in UK jurisdictions: Many targeting tools are available on the commercial market, and many others have been developed by in-house teams working in local authorities and energy retail corporations. However, none meet the following criteria, all of which are embodied in Northern Ireland's targeting strategy:

- none are based on comprehensive criteria, each one weighted in terms of its evidence-based association with fuel poverty; for example, prevailing temperatures in micro-regions are seldom included, nor are historical data on recent energy efficiency initiatives in an area;
- none of them have been validated by independently testing the targeting tool predictions against conditions in people's homes;
- none are able to operate in small-scale geographical areas such as neighbourhoods or housing estates.

[70] Under the Boardman definition of fuel poverty

In brief, Scotland has the closest resemblance to Northern Ireland in terms of the development of a workable area-based targeting strategy. However, their zones are larger than those which can be deployed in Northern Ireland (500-1000 households in Scotland, 150 households in NI). To date their targeting tool has yet to be validated, but the developers currently speculate that its robustness is likely to be confined to finding areas with more than 40% of homes in fuel poverty (of one severity level or another). That being said, their approach has yet to be validated, and results may be more optimistic than they anticipate. It would, however, remain a tool that identifies saturation of fuel poverty in an area, rather than areas with individual households that are in very extreme need.

Table 2 contains a brief comparative summary of the targeting approaches currently available in the four regions.

Table 2: Area-based targeting in the UK's regions: six comparative criteria

Criterion	England	Scotland	Wales	NI
Is the targeting of households most in need viewed as a priority for the region?	Yes	Yes	Yes	Yes
Are area-based targeting tools already deployed at Ward or smaller geographical level?	Yes	Yes	No	Yes
How small is the area that targeting can be deployed?	Clusters of 1500 households but with caution concerning accuracy; more confidence at the larger Ward level	500-1000 households but with caution concerning accuracy; more confidence in areas of high prevalence	n/a	150 households
Has the targeting tool been validated with household survey data?	No	No	n/a	Yes (n = 2,145 households)
Is the tool systematically applied?	No	No	n/a	Yes
Has the targeting tool been subject to scientific peer review and open access publication?	No	No	n/a	Yes

In summary, for more than five years, area-based approaches to addressing fuel poverty have been under development in many European countries as well as other regions of the UK.

Northern Ireland alone has a fully-validated area-based algorithm through which to identify areas most in need. It relies on close cooperation between UU's fuel poverty team, the expertise of fuel poverty experts working in local Councils, and specialist administrative teams operating out of local offices of the NI Housing Executive

As such it is not only the most fully developed and tested model for area-based targeting, but it also represents many aspects of best practice in the field of cross-sector cooperation.

Technical Report 5: Delivering the Affordable Warmth Scheme in Phase 2 - consultation with local Council teams.

As part of the work undertaken to build a new area-based fuel poverty targeting algorithm, UU sought the views of local Council teams who had generated referrals under the AWS2 algorithm. This enabled the UU team to gain a better understanding of how addresses had met their needs, and whether there were any consistently expressed views about what a new algorithm should improve upon.

The fuel poverty delivery teams of 11 Councils were asked whether a short meeting could be arranged. There was no agenda, and no pre-prepared questions, enabling each Council to frame the meeting as they wanted to. One Council did not feel it necessary to meet, and unforeseen events meant that a meeting before the end of 2017 could not be arranged with a second Council. Hence the views of 9 Council teams are represented in this summary.

At the outset it should be made clear that all Council teams who were consulted expressed a strong endorsement of the principles behind a targeted approach.

Most Council teams also felt that they had identified a wide diversity of people in extreme fuel poverty who would otherwise have been hard to reach.

The address lists of areas for targeting had, therefore, made a longstanding and substantial contribution to the portfolio of work they undertook in support of vulnerable people.

UU's purpose in undertaking this consultation was, as stated above, to seek ways of making any new algorithm better than its predecessors, in terms of meeting the needs of Council teams on the ground. However, opinions on that specific issue were often mixed with a diversity of opinions on other more generic matters. As an impartial rapporteur, and for the sake of accurate representation, all themes that arose regularly during consultations are documented here.

Care has been taken to distinguish unanimous views from those consistently expressed by only a sub-set of Councils. What is particularly noteworthy is that a large proportion of issues were in fact raised by *all* Councils – there were few issues which were not challenging for everyone. Relatively few of these concerned the algorithm itself, most being concerned with how teams were asked to generate referrals.

The Summary is in two parts. The first consists of a list of the issues raised, with areas of particular concern being described first. The second consists of information regarding Council requests for changes to the algorithm.

Section A: Council concerns about AWS, listed in order of priority

5.1. Waiting lists from non-target areas

Waiting lists comprised clients who had contacted the Council to apply for assistance from the AWS2 Scheme, but who were not in a designated target area. The length of waiting lists varied widely between Councils, ranging from:

- no formal waiting list having been collated (this was rare);
- to a waiting list of 900 households. All client waiting lists were in the hundreds, and for most Councils their lists consisted of clients who had been fully scoped and found to be eligible for assistance under AWS2 criteria i.e. they were a sub-set of the list of callers who had enquired about the Scheme.

Consequently, although large, the lists of eligible clients did not reflect the full burden of calls that had to be processed from non-targeted areas. For one Council, calls concerning AWS averaged 120 per week, an average of 24 per day. Many Councils believed that there were more calls to Environmental Health about AWS than about any other topic related to their services.

AWS teams relied on staff from other areas of the Council to deal with these calls most of the time, since they spent much of their own time out of the office generating referrals in target areas. It was noted that this level of demand reflected the level of interest and demand for a scheme which helped households deal with fuel poverty.

Some Councils felt that the addition of boiler replacement and double-glazing to AWS2 services had generated peak interest in the Scheme. Other Councils were aware that their elected representatives had become much more proactive in responding to issues related to fuel poverty, and that this too generated a larger response from untargeted areas than had hitherto been experienced. Some retrofit contractors had also disseminated misleading information about eligibility through advertising campaigns on websites and word of mouth. The extent of mis-information, from a wide variety of different sources, has been considerable, and took time and patience to unravel when Council teams fielded calls.

None of the Councils expressed resistance to a *significantly targeted* element to any new programme, and all Councils expressed satisfaction with the people they reached via the targeted addresses. But they required more flexibility in treating non-targeted referrals, and better financial support for their efforts in handling the demand from non-targeted areas.

Hence, all Councils felt that there was a need for greater flexibility in terms of how people from outside target areas might be treated, with a 20% limit being seen as too small a proportion of their referral quota. The increase in related services they were managing - such as food banks, cooking classes, sewing classes, support for prisoners on release, family support hubs - were cited as supplementary examples of referral routes for identifying households in greatest need; some Councils would have appreciated more opportunity to tap into these other options.

Extensive efforts were made to seek alternative forms of assistance for callers from non-targeted areas, whether via NISEP and other similar fuel poverty schemes, or through referral to energy efficiency advisers, home safety officers, and/or other

services offered by the Councils or their networks of contacts. The same services were also offered to applicants in targeted areas who failed the AWS2 eligibility criteria, meaning that these *additional services* reached a large number of residents.

Some Councils felt that any client in very dire need was treated as a matter of urgency by their NIHE colleagues, regardless of whether they were from a target area or not. In this sense, they were not aware of any client at manifest and severe risk being excluded from the scheme on the grounds of living in a non-targeted area. In most cases, urgent cases (whether targeted or not) were attended to within 1 working day by their NIHE colleagues.

The fact that many Council teams carried emergency kits including electric blankets, warm clothing packs, soup, and heaters is testimony to some of the extreme levels of need that they encountered in delivering AWS2; but these levels of need are seldom if ever confined exclusively to targeted areas.

Councils who frequently exceeded the 20% constraint in making their referrals were not aware of their extra non-targeted referrals being excluded from help – the constraint did not seem to be binding, in other words. But this in itself created a sense of inequity among Councils, since some had sought to apply this constraint with rigour.

As a consequence, Councils who had conformed to the 20% limit were also the Councils who ran out of addresses during the course of AWS2, leaving them with limited options for filling their quarterly quotas. Hence, compliance with the quota constraint led, in turn, to yet another form of restriction in what some Councils could deliver i.e. a limited number of addresses with which to work.

The databases of Council teams who:

- kept databases of waiting lists from non-target areas,
- and had scoped each of these to assess eligibility for AWS2

indicate that between 0.6% (Newry, Mourne & Down), 1.4% (Mid-Ulster) and 3.5% (Derry City and Strabane) of <u>all</u> owner-occupiers and private renters in any one Council may presently be on a non-targeted waiting list. Clearly the level of demand for the AWS scheme is unprecedented, and growing.

It is difficult to see a means by which this level of non-targeted demand can be addressed in future without a significant shift in how eligible applicants from non-targeted areas are classified.

There are logical explanations for the accumulation of wait-listed clients, which include:

- a tendency for some Councils to take the details of more self-referral applicants than they could process given the constraints of the AWS programme; many were under considerable pressure to take these details;

- a tendency for installers, MLA's and other stakeholders to encourage households to apply to the programme, often through misinformation about their eligibility;

- word of mouth across areas, particularly when retrofit works were being undertaken in one area, often adjacent to a non-eligible area.

Addresses for targeting the small geographical areas in a Council were based on the small areas which had the 25 highest fuel poverty severity scores; addresses from these 25 areas were given to Councils as their target list. Any applications to AWS which were from areas not on that list became self-referrals.

Analysis carried out by UU on the location of self-referrals was carried out to seek further clarity on the issue. Derry City was used as the exemplar. For Derry City, there are a total of 237 Small Areas. Hence, the 25 most eligible for AWS2 comprised about 10% of all Derry City's small geographical areas.

The average eligibility score in those 25 highest scored areas (where eligibility for AWS2 was greatest) was **51**.

If the list had then gone on to encompass the *next 25* most eligible areas, (severity scores for the 26-50th highest scores) their average score would have been **48.** In other words, there is relatively little to distinguish the 25 most eligible areas (average score 51) from the next-most eligible 25 areas of Derry City (average score 48).

The question then can be reasonably asked: how many of Derry City's self-referrals came from those *extra* 25 areas? That is: how many would come into the frame for targeting if a 26-50 principle were applied?

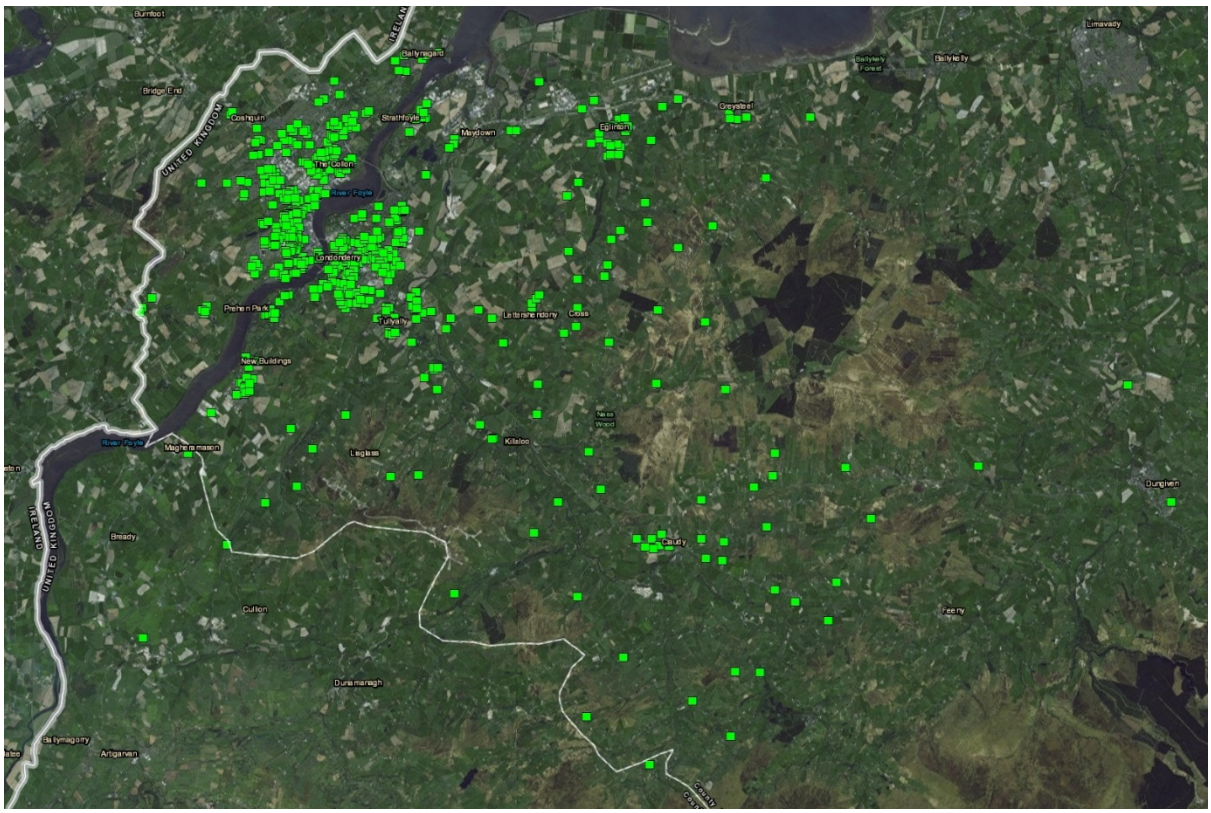
UU obtained the postcodes of self-referred households on the waiting list for Derry City. These were mapped with a geographical match for 195 self-referred households. Figure 9 shows where these are located.

In total, 114 of 194 self-referrals into Derry City Council come from the small areas in the 26-50 most severe in terms of FP scores, almost 60%.

When the DfC team assume ownership of the 2018 algorithm, waiting lists from all 11 Councils could be examined in this manner, to see how many self-referrals are now in the top 70 under Algorithm 2018 but were *not* selected by Councils – these self-referrals could then be added to their address lists, and possibly fast-tracked to NIHE.

Going further, all self-referrals could be checked to see whether they fell in the top 100 most eligible small areas, since the analysis for Derry City suggests there may be a large proportion of wait-listed clients in this wider net. All of these wait-listed clients could reasonably be added to the list of households for fast-tracking. This is a more flexible approach and would clear more households from Council waiting lists at the start of AWS3.

Figure 9: location of self-referrals into the AWS Programme – Derry City (n = 194)



From discussions with Council teams, there is considerable appetite for making a significant effort to reduce their waiting lists. The above suite of solutions gives an evidence-based rationale underpinning that. It will work better for some Councils than others, but the worked example for Derry City gives some idea of its potential.

5.2 Remuneration

The budget Councils are presently allocated has to cover their costs for generating fully-scoped referrals and the paperwork associated with that. Firstly, the application form itself is formidably long and complex, and contains little in the way of guidelines or examples for clients to use in filling it in. The form could very rarely be left with a client to tackle by themselves. Secondly, verification of documentation is required for every applicant - documentation which includes proof of house ownership, details of income, and a great deal of other information which is both sensitive and complex[71]. The *nature of the scheme* means that many referrals require multiple home visits, and the *nature of the clients* being targeted means that many are vulnerable, frail, and anxious. These features of AWS mean that considerable effort is needed to build trust and confidence, as well as to gather up all the information needed to verify an application.

[71] Some Councils noted that, when NIHE completed most of this administrative work with clients in the past, only 10% of documentation was checked, which they felt was a more reasonable demand.

Council teams were unanimous in their view that their role in AWS2 had been undervalued, and that the costs of their involvement exceeds what the AWS2 programme pays for their services.

In estimating the returns from AWS2, Councils described many value-added outcomes, which had not been taken into account when assessing the costs and benefits of AWS2. One Council team described their role in delivering AWS2 as a "*multi-purpose foot in the door*".

Council teams perceived themselves to be uniquely situated in terms of knowing where other resources and forms of assistance could be located in their neighbourhoods, and in ensuring that these were harnessed to full advantage.

Their own costings suggest the need for at least 18% more funding in order to cover costs[72].

The majority of Councils were supportive of the idea that an independent cost-benefit analysis be carried out, to review what might be considered reasonable remuneration.

Here, it must also be noted that Councils feel themselves more than capable of delivering their maximum current quota from DfC (n = 40 referrals), given the scale of need. Some Councils believe they could deliver more than 3 times their maximum quota, and most of the others twice their quota. However, this cannot be achieved on the budget and resources which they have at their disposal.

Over the past three years, payments to Councils for their services in generating referrals to AWS2 are estimated to have comprised 6.6% of the total AWS2 budget. This percentage has shrunk during that time (and more-so if financial support is traced back to when the AWS scheme first launched), since DfC's budget allocation to Councils has been systemically reduced over time. Crucially, however, the quality of referrals which Councils are expected to make to the Scheme is vastly more challenging now when compared to the time at which AWS2 commenced, since Councils are now having to oversee the completion of application forms, and are required to verify 100% of each client's documentation.

[72] If all overheads, works in kind, and value-added returns from the Scheme were factored into an independent cost-benefit analysis, UU estimates that remuneration per referral from Councils would double. If it *were* to double, the transaction costs for a successful referral would still remain a very small percentage of the investment made in the Scheme as a whole. In other words, the strong business case for AWS would not be significantly weakened by fairer remuneration.

Under the current remuneration level, short-cuts have been adopted to ensure quotas are met whenever possible, whilst containing costs. Few of these shortcuts are in keeping with the ethos and aims of the AWS Scheme. For example, the practice of visiting every address in their target area is seldom implemented now, with most Councils gathering referrals from households who choose to respond to a letter from them. Households who do not respond are not followed up on, meaning that the scheme is moving back into a form of self-referral.

Households with greatest vulnerability and fewest resources are those most likely to be in need of assistance from AWS, but they are also households least likely to respond to a letter. This risks missing the most vulnerable households altogether.

5.3. A longer-term and stable programme of work

The changes in the quarterly targets DfC set for Councils, which had taken place throughout the course of AWS2, were sometimes swingeing. In the past year, for example, quarterly quotas varied by as much as 60%. This had substantial impacts on their capacity to deliver AWS2, since the time taken to recruit and train new staff had been a significant burden. Staff turnover was unusually high, partly as a result of the demands of the job, and partly because there was no longer-term job security.

Some Councils had started with four full-time members of staff, but were now operating with only one part-time person. For such a person to cope with a 60% increase in workload from one quarter to another was problematic, but to recruit an extra member of staff (for what might be a very short-term increase in quota) was equally so.

Councils noted the value that would accrue from being given a 3-5 year plan within which they could deliver a steady rate of referrals each quarter.

5.4. Feedback from NIHE colleagues

At best (and there were many "bests"), the relationship between Council teams and their NIHE colleagues was described as "good" to "excellent"; at worst it was described as "improving". This suggests that the collaboration is generally working well; following what everyone agreed was a difficult start in Year 1. Nevertheless, there were three consistently-mentioned problems.

First, the time taken to complete measures in eligible households. There were occasions when delays of over four months occurred between the time a Council uploaded a referral to NIHE, and NIHE making contact with the client.

Second, the sparse feedback provided by NIHE on the outcomes of all referrals. Some Councils pointed out that they received excellent and rapid feedback when they made *specific* requests about a client or issue, but that they would have found more detailed *routine* feedback very helpful.

For example, whilst Councils receive a list of cancellations, they are not often given the reasons for cancellations. Most Councils felt that they might have been able to resolve obstacles which only emerged after handover to NIHE. Given the effort that Council teams often expend in getting a client to the referral stage[73], they expressed frustration at the lack of information on how a failure could have occurred at the final hurdle.

This issue was substantial: cancellations after referral to NIHE had sometimes been as high as 50% of all referrals.

At least one Council had also not received a list of cancellations for some considerable time, and so could not comment on this matter.

Several Councils had the impression that NIHE teams might be somewhat more process-driven than client-driven, and that for this particular scheme a more nuanced and personal approach was essential. Delays of 3-4 months in NIHE teams engaging with a referred client, coupled with what is perceived to be a more distant and statistical approach, could have led to vulnerable households losing trust in the Scheme.

Third, Councils are not offered an opportunity to replace a "failed referral", and this applies both when a household fails to meet criteria after referral to NIHE, as well as to cancellations. Given severity of client need and long waiting lists, this combination of

- being unable to find solutions for some cancellations through lack of feedback from NIHE

- and being unable to submit a new referral as a replacement for any which do not progress

is challenging for Council teams, and could perhaps be remedied.

[73] The number of visits to people's homes varies across Councils, and between clients, but probably averages at around three home visits per referral.

Case studies of success stories, fed back to Council teams, were mentioned as a useful supplement in the future. This would be particularly useful in terms of persuading elected Council representatives to continue supporting AWS, which (as noted below) can no longer be taken for granted in some Councils. Alternatively an independent evaluation of "customer journeys", undertaken as part of any future Scheme, was recommended by some Councils. This would need to be fully integrated into Scheme delivery, and Councils wished to have input in terms of the design and outcomes of an independent evaluation[74].

5.5. Piloting a scheme where Councils work together

Views expressed on this issue were less consistent, but were raised by more than half of the Councils that UU consulted. There were two elements to it.

First, while the reason for DfC asking all Councils to deliver the same number of referrals per quarter ensured a certain aspect of even-handedness, many Councils questioned the logic of this, given widely varying rates of fuel poverty between Councils, as well as widely varying populations within Councils.

It is important to mention that this issue was not just raised by Councils who felt they had high rates of fuel poverty, and should therefore have had a higher quota. Rather, the inequity associated with giving each Council the same quota was mentioned by several Council teams for whom there was no gain to be had from changing the status quo.

There may be scope for debate in the short-term on whether Council teams will be able to unanimously agree on a different formula for deciding on monthly targets, one which takes into account the degree of need and other considerations. Here, however, caution should be exercised in estimating varying degrees of need across Councils. The UU algorithm for targeting does *not* estimate fuel poverty prevalence in Councils. Rather, it estimates the extent to which the small areas making up a Council are "saturated" with households likely to be eligible for assistance from the AWS programme. The correlation between *fuel poverty* and *eligibility for* AWS is modest – there are, for example, many small areas in Northern Ireland which have a high fuel poverty prevalence, in which households are above the median income for Northern Ireland. The UU algorithms are designed to exclude such areas from consideration. In this context, it should be noted that the 2006 NI House Condition Survey data indicated that more than 17% of households earning more than £30,000 per annum lived in homes with SAP scores under 40. These were quite likely to be fuel poor, but would not be considered eligible for assistance from a programme such as AWS.

[74] A range of experienced and independent evaluators outside of Northern Ireland are likely to respond with a bid, should an invitation to tender be published

Stemming from concerns about equity, some Councils raised the prospect of experimenting with flexible and voluntary clusters, operational across different geographic areas. Teams from different Councils could, if they wished, operate as larger multi-Council clusters, sharing information, workloads, and targets, working to ensure that every Council's quota was met. This could, it was believed, lead to a fairer distribution of AWS services based on areas of greatest need. Prior to AWS, it was pointed out, this cluster-based system was familiar to many fuel poverty teams, and it had built an excellent reputation.

5.6. Ensuring Councils have enough addresses to meet their quota.

How many addresses a Council needed in AWS2 largely depended on how they treated unsolicited applications for assistance from AWS2 i.e. applicants who were not in the target areas. As noted earlier, Councils had been asked to limit the number of non-target referrals to 20% of their monthly referrals to NIHE.

Teams which adhered fully with this constraint ran out of addresses during the course of AWS2, and found that repeated contacts to target addresses engendered few extra referrals – as well as some degree of irritation from residents.

For those Councils whose addresses were clustered in urban areas, many found that these were households in private rented accommodation, which (given the 50% reduction in retrofit funding being offered to landlords under AWS2) resulted in even fewer referrals than they had hitherto experienced, leading to a need for a larger address list.

Greater flexibility at DfC in terms of supplying more addresses (where needed) would have been appreciated. Whilst drawing additional addresses is time-consuming, it seems likely that more flexibility in providing extra addresses would be welcome. However, UU did not probe, and nor did Council teams volunteer, any substantive action plan which would satisfy the need for greater flexibility.

5.7. Summary

Councils were unanimous in their view that the AWS scheme "worked". But they were also unanimous that AWS could work much better in the future, provided some core issues were ironed out satisfactorily.

Everyone consulted expressed the view that their own Council teams were "deeply committed to AWS", "passionate", "always going the extra mile", but that they were often left feeling frustrated and unsupported by DfC.

More worryingly, almost half of the Council teams felt that their Executive was losing faith in the Scheme, because it was becoming too burdensome. Executive members

perceived increasing levels of in-kind support being asked of their workforce, which were needed to handle the growing burden of calls and referral paperwork. All Councils were aware of this sentiment, even if their own Council remained broadly supportive at present.

There is far-reaching support and real commitment to the principles of AWS among delivery teams working on the ground. However, there is also a palpable sense that ever-changing quotas, the current rate of work, and the present level of remuneration being offered to their Executives cannot persist indefinitely.

Council teams are not without ideas and innovative suggestions for how to solve these issues, although they need more resource in order to deliver (or at least pilot) solutions they believe will improve the Scheme.

Section B: Requested changes to the algorithm that Council teams suggested

5.8. Relaxing the boundaries imposed by specific address lists

Most Councils expressed a strong preference for a list of *postcodes* they could target instead of a list of specific *addresses*. This would increase their ability to classify a referral as *within the general target area*. For example, a postcode of BT52 1SG could be combined with BT52 1SF and BT52 1SH to yield a larger generic area.

Paul McKenzie is UU's GIS expert on this project. He explored this option, since we could see the logic of such a change. However, a postcode based list would not provide reliable results. Postcodes adjacent to each other are not always sequential, and even where they are, adjacent postcodes can vary substantially in terms of their fuel poverty risk scores (the scores used to generate addresses).

However, Dr. McKenzie has outlined a way in which Councils could be given both a specific address list and an area-based map of their target areas, as UU did in AWS1. This would allow Councils to move somewhat beyond the confines of the GIS-based address lists, perhaps by as much as a kilometre in any direction. This would be particularly appropriate in circumstances where a small area of greatest need was abutted by areas of lower, but still above-average need. It would recognise the fact that GIS boundaries are arbitrary lines on a map, whereas the "view on the ground" when Councils work in an area is always much more fuzzy in terms of deciding where an area of greatest need stops and starts.

We have analysed the database of AWS2 completed works[75], and it is apparent that most completed works in non-targeted areas are located in areas close to targeted areas. Hence, this relaxation of boundaries through working from maps would be an effective way of catering for both targeted addresses and non-targeted addresses nearby.

5.9. Include areas with high concentrations of social housing

In previous algorithms, the UU team discounted any small areas in which more than half the properties were owned by NIHE. This helped ensure that Council teams were being directed towards areas where there was a high proportion of owner-occupied or privately rented homes. When knocking on each door was common practice, this saved teams a great deal of time. Since it is no longer common practice, there is an opportunity for change.

There was consistent support from all Councils for allowing the targeted addresses to come from any areas, regardless of the proportion of NIHE properties. As was reasonably pointed out to us, areas with a high concentration of social housing are often more likely to be areas in which an owner-occupier/private renter is in above average need, being more likely to have a low income and poor living conditions.

UU was therefore asked to drop the exclusion criterion, and we propose to do that.

[75] NIHE supplied this, and we are grateful for their cooperation

5.10. Bring in other databases

An enquiry was also made as to whether the algorithm could factor in area-based numbers concerning free school meals, since food poverty was becoming an increasing concern. UU has requested this data at small area level from Government, but the request has been turned down.

Other requests made by UU for better databases to use in the algorithm included requests for data on working tax credit and child tax credit at small area level, since these are strong correlates of poverty. These requests were also turned down.

5.11. Factor in recent changes in oil-versus-gas energy costs

UU was asked by some Councils to re-assess the extent to which residents in areas with gas connections might now be just as fuel poor as residents in areas with no gas connection.

UU plans to take account of the lower price differentials between gas and oil in the new algorithm, using data from the two most recent issues of the Sutherland Tables.

UU has also been given access to new data on the number of gas customers per small area, so that an appropriate weighting can be given to areas on the basis of *actual* connections to gas in any one small area.[76]

5.12. A change proposed by UU

Council teams were asked whether they would agree to a change which UU was proposing to make in the new version of the algorithm. The background to this change is as follows:

In 2017, Scottish Government funded UU and others to carry out a review of their fuel poverty definition. This was published in October 2017[77], and recommended that fuel poverty in Scotland be re-defined in a manner which reduced the emphasis on buildings and measures, and instead highlighted the human impacts of fuel poverty – that is, its effects on hardship, adverse living conditions, human health, and wellbeing. The Review Panel concluded:

'*There is a growing need to reframe how fuel poverty is defined in Scotland, with greater prominence being accorded to issues of energy injustice and inequality. Over and above the classic metrics of income and required energy cost, a new definition should capture the lived experiences of people affected by fuel poverty, especially those for whom energy costs incur enduring hardship and adversity.*

In that context, a new definition should reflect a balanced combination of objective and consensus-based metrics. This combination is likely to point towards a greater diversity of causes and consequences, and hence a wider range of potential tools for alleviating fuel poverty than has hitherto been acknowledged.'

[76] We are grateful to SSE and firmus for their cooperation in providing us with this information

[77] http://www.gov.scot/Publications/2017/11/7715/downloads

In developing the new algorithm for AWS3, we propose to adjust the algorithm so that it more adequately reflects these more "human" aspects of fuel poverty and its effects on hardship, health and wellbeing.

In previous algorithms, the fuel poverty severity scores for small areas were calculated from summing two multi-faceted indices:

- A housing energy efficiency index, based on measures such as age of dwelling, floor area, location, type of dwelling, SAP estimates, etc.;
- An area resources index, based on measures such as employment, income, receipt of benefits, weather, etc.

In the new algorithm, we propose to add a third summary score, namely an "area vulnerability score" which will reflect the level of vulnerability to the adverse impacts of fuel poverty that prevails in each small area. Hence an area with a high proportion of elderly people, people who rate their health as poor, areas with a large proportion of young children, etc. will have a higher *area vulnerability score* than an area in which residents are largely young to middle-aged adults in good health.

Hence the new algorithm will generate fuel poverty risk scores for each small area, based on scores related to three rather than two indices: the area's housing energy efficiency index, household resources index, and residents' vulnerability index.

Councils unanimously thought this change was acceptable. An important consideration here will be the extent to which this new algorithm will direct Councils to areas where households are even more vulnerable than they have been under previous algorithms. In other words, it is likely that Councils will be working in even more fragile areas than hitherto.

5.13. Miscellaneous requests

These are recorded here, since they were discussed during meetings between UU and Council teams. However, they have no bearing on a new algorithm.

If the proposed change in income thresholds comes into place during AWS3, some Councils would like a new opportunity to re-contact those applicants from AWS2 who narrowly missed the scheme through the previous income threshold. In one Council, for example, 906 households failed the income criterion, the majority of which may pass the revised criteria proposed for AWS3.

Similarly, the proposal to remove disability allowance from estimates of income means that some Councils would like an opportunity to re-assess those clients who had previously failed the AWS eligibility criteria as a result of their allowance being treated as income.

Technical Report 6: Composition of the 2018 algorithm

Since the original algorithm was developed, a great deal of research has been carried out which related explicitly to a targeting algorithm of this nature. In addition, areas of best practice are now emerging across the UK and worldwide which can help inform how the original algorithm could best be improved upon.

The Housing Health and Safety Rating System (launched in 2006) remains the UK's central tool for assessing whether a property is fit for habitation, and if it is not, where the risks to human health and wellbeing lie and how serious these risks are. Consultation was recently undertaken to assess its present fitness for purpose (CIEH, 2017). Practitioners were strongly in favour of this risk-based tool, largely because it focused on the people who might occupy a property rather than on aspects of the building in isolation. The 2018 AWS algorithm reflects this view, including as it does a score derived from three sub-scores:

- A property score
- A poverty score
- A vulnerability score

the last 2 of which encompass household resources and risks, as these pertain to fuel poverty.

Technical report 6 is divided into two main sections. Section A outlines the computation process used in generating the Affordable Warmth Scheme Eligibility Measure. Section B outlines the main spatial data and analysis that was carried out to produce statistics for Small Areas in Northern Ireland.

Section A: Computation of the Affordable Warmth Scheme Eligibility Measure

A series of spreadsheets provides details of algorithm parameters and construction, as well as the final output in terms of AWS eligibility scores and the composite sub-scores (property, income and vulnerability ranks). This series accompanies the current report. What follows is a narrative account of how the algorithm was constructed.

6.1 The basic database has 109 variables to describe the 4537 Small Areas in Northern Ireland (see Data sheet of the spreadsheet). The details of the variables are provided in Table 3 and in the Metadata sheet of the spreadsheet. The origin and characteristics of these variables is very disparate, and it is unlikely that they will remain constant over time It is recommended that those tasked with future updates ensure that they have and retain access to the expertise needed to assess the impact of future changes in the data.

6.2 Not all of the variables are required for production of the Affordable Warm Homes (AWH) Measure although they provide useful supporting background information. The number of variables is reduced to 48 key variables. Some of these relate to the geographical characteristics of the Small Area, while others link directly to benefits receipt, property characteristics, energy costs, temperature, poverty, and cold vulnerability (see 1. Select Data sheet of the spreadsheet)

6.3 In the 2. Reordered Data sheet of the spreadsheet, a number of adjustments are made. Many of the data counts are adjusted to a ratio by reference to an appropriate calibrator (people [Column F], households [Column E] or properties [Column K]) to ensure that areas with relatively large populations only attract attention if their disadvantaged populace is disproportionately numerous. The average cost of oil is calculated as the average of the cost of 300 litres, 500 litres and 900 litres of oil in the Small Area. The proportion of properties connected to the gas network by Firmus and Phoenix is calculated from figures as supplied. It is not always certain whether this is the number that might be connected if the householder so chose (bearing in mind that not all householders in an area are necessarily being offered a connection at present), or the number who are currently connected (which might be substantially fewer than the potential connections).

6.4 The 3. Index A and 4. Index B sheets of the spreadsheet, variables are prepared and converted to an index[78] which transforms all values into a number that lies in the range 0-1, where 0 is the least disadvantaged Small Area in Northern Ireland and 1 is the most disadvantaged Small Area. This indexing places all variables on the same basis, so that when they are combined, excessive weight is not given to measures such as average house price (NI average £110,000) with large numerical values, rather than other measures such as SAP (Maximum theoretical value 120) whose numerical values are much smaller.

[78] (Small Area Score- minimum value)/(maximum value – minimum value)

6.5 In the 5. Process sheet of the spreadsheet, variables are averaged and then the average is rebased to the scale 0-1, since it cannot be assumed that the average retains the scale properties. The groups combined are:

a) The Vulnerability Component of AWH Measure is the average of: Vulnerable young, vulnerable old, vulnerable due to ill-health and vulnerable to disability. It has a final weight of 20.
b) Poverty Measure: average of Pension Credit, Jobseekers Allowance, Disability Living Allowance, Employment Support Allowance, Housing Benefit, Income Support:
c) Anderson Measure: average of Super Output Area Households with income 60% or less of NI median income (both equivalised and unequivalised), Super Output Area Gini Coefficient.
d) The Poverty Component of the AWH Measure is the weighted average of the Poverty Measure (weight 60) and the Anderson Measure (weight 40). The Anderson Measure is given less weight because it relates to wider Super Output Areas rather than to any specific Small Area, and because it has not been updated for a good many years. There are no known plans for an update. The Poverty Measure does not include HMRC data on tax credits, which would be valuable information on the numbers of the working poor in each Small Area. The data was requested, but it was noted at that time that the past record of requests for HMRC data on small areas to researchers working on behalf of NI government, over the past decade has been one of prolonged delays followed by refusal citing various data protection legislative issues, many of which have just been on the verge of resolution throughout the entire period. Accordingly, the analysis was designed on the assumption that HMRC data would not be available. The assumption was correct. The Poverty Component has a final weight of 40.
e) SAP Measure: the average of Current and Potential SAP, inverted since a high SAP is a measure of low need for fuel.
f) House Type Measure: the average exposure of house types in the Small Area to heat loss due to their configuration (values as shown)

Apartment	Detached	Terraced	Semi-Detached	Other
0.2	1.0	0.7	0.8	0.9

g) House Value Measure: the average capital value of properties, inverted because more expensive properties are considered more likely to have improved insulation
h) House Size Measure: average area of properties, inverted because bigger properties require more heating
i) House Age Measure: average construction date of properties, inverted because older properties tend to have poorer insulation design
j) Temperature Measure: average of Mean Temperature, Mean Temperature Shortfall, Mean Degree-days. These were originally computed for Census Output Areas and revised estimates were devised for the new Small Areas

k) The Fuel Need Component is the weighted average of SAP Measure (weight 30), House Type Measure (weight 15), House Value Measure (weight 5), House Size Measure (weight 15), House Age Measure (weight 5) and Temperature Measure (weight 30).
l) Fuel Price Measure: average price of oil, adjusted by a 2% discount for those households deemed to have access to cheaper natural gas, which is discussed in more detail at Point 7.
m) The Fuel Cost Component is the product of the Fuel Need Component and the Fuel Price Measure. It is effectively also the Housing Component of the AWH Measure when indexed and given a final weight of 40.
n) The final AWH Measure score is derived by summing Housing Component (weight 40), Poverty Component (weight 40) and Vulnerability Component (weight 20). The theoretical maximum score is 100, but in practice, the maximum proves to be 66.3, with a minimum score of 13.7, and an overall average of 39.7.

6.6 The three AWH components and the AWH total are shown, together with Small Area code, Small Area Name and Local District Area, in 6. Output Sheet of the spreadsheet.

6.7 Determining how domestic gas and oil prices would be weighted was carried out as follows:

- For the AWS2 algorithm, UU compared Sutherland Table costs for:
- homes that were gas fired with condensing boilers (since it was unlikely that a house newly connected to gas in 2011 would have an old boiler)
- with homes that were oil-fired with older boilers (non-condensing) (since we did not anticipate working in areas where new condensing boilers were the norm).

In AWS2, in order to cater for the differential between costs for gas and oil, we multiplied the final FP scores in areas that were connected to gas by 0.95. This was based on gas being 40% cheaper than oil, but also based on a relatively limited uptake of gas in areas where it was available. Several years later for the AWS3 algorithm, many more homes are connected to gas, but most of them are new homes, as we have been able to establish from data supplied to us by firmus and SSE Airtricity NI[79]. Areas we wish to target with the AWS3 algorithm remain older, less energy efficient homes, where residents will find the cost of oil to gas conversion challenging to meet.

Table 3 illustrates gas and oil prices used in the AWS2 algorithm, and at the time the 2018 algorithm was being built. Gas is now only 18% cheaper than oil. We have therefore increased the likelihood that small areas connected to gas will be ranked amongst the top 70 areas in need of assistance from AWS3. This has been achieved through altering the weighting from 0.95 to 0.98 when making the adjustment of final eligibility scores for small areas.

[79] UU wishes to express gratitude to firmus and SSE Airtricity NI for their rapid response to our requests related to this issue

Table 3: Gas and oil prices used in original AWS algorithm, and in 2018 algorithm: Annual cost of space and water heating, 3 bedroomed house (Sutherland Tables, 2010, 2011, 2017)

Date	Gas-fired with condensing boiler	Oil-fired with non-condensing boiler	Averages	
January 2011	£793	£1469		
October 2011	£1029	£1562		
Average 2011 winter quarters	£911	£1516	40% more for oil-fired sources	Multiplied final FP score by 0.95 for areas on gas network
January 2017	£825	£1043		
October 2017	£894	£1053		
Average 2017 winter quarters	£860	£1048	18% more for oil-fired sources	Multiply final FP score by 0.98 for areas on gas network

Table 4: Metadata

Field	Description	Label
SA_Code	Unique Code for each Small Area	Small Area Codes
SA_Name	Small Area Name	
PC_2016	Pension Credits for 2016	Benefits data
JSA_2016	Jobseekers Allowance for 2016	
DLA_2016	Disability Living Allowance for 2016	
ESA_2016	Employment Support Allowance for 2016	
HB_2016	Housing Benefit for 2016	
IS_2016	Income Support for 2016	
Shape_Leng	Perimeter of each Small Area	Spatial data
Shape_Area	Area of each Small Area (m2)	
Area_HA	Area of each Small Area (ha)	
X	X centroid of each Small Area	
Y	Y centroid of each Small Area	
LGD2014	LGD Code 2014	Geography Lookup
WARD2014	Ward Code 2014	
DEA2014	Electoral Authority Code 2014	
Postcode	Main postcode for each Small Area (approx)	
CntPC	Count of postcodes with SAP records in SA	SAP
CntHHlds	Count of households in postcodes	
MinAvCur	Lowest current SAP record in SA	
MaxAvCur	Highest current SAP record in SA	
AvCur	Mean of all current SAP records in SA	
SdCur	Standard Deviation of all current SAP records in SA	
MinAvPot	Lowest potential SAP record in SA	
MaxAvPot	Highest potential SAP record in SA	
AvPot	Mean of all potential SAP records in SA	
SdPot	Standard Deviation of all potential SAP records in SA	
MinAvDif	Lowest difference between current and potential SAP in SA	

MaxAvDif	Highest difference between current and potential SAP in SA	
AvDif	Mean difference between current and potential SAP in SA	
SdDiff	Standard deviation between current and potential SAP in SA	
SOA2001	Super Output Area Code 2001	Geography Lookup
SOANAME	Super Output Area Name 2001	
COA2001_1	Census Output Area Code 2001 (1)	
COA2001_2	Census Output Area Code 2001 (2)	
COA2001_3	Census Output Area Code 2001 (3)	
COA2001_4	Census Output Area Code 2001 (4)	
NIHE17	Count of Northern Ireland Housing Executive Properties in each Small Area from 2017	NIHE data
NIHE11	Count of Northern Ireland Housing Executive Properties in each Small Area from 2011	
Dif_NIHE	Difference between Housing Executive properties in each Small Area from 2011 - 2017	
Apartment	Number of apartments in each Small Area	Property type
Other	Number of other properties (e.g. caravans) in each Small Area	
Detached	Number of detached properties in each Small Area	
Terrace	Number of terraced properties in each Small Area	
SemiDet	Number of semi-detached properties in each Small Area	
DOTypeCNT	Number of properties with a domestic type label in each Small Area	
Min_300	Minimum oil price for 300 L	Oil data
Max_300	Maximum oil price for 300 L	
Mean_300	Average oil price for 300 L	
Range_300	Range of oil prices for 300 L	
STD_300	Standard Deviation of oil price for 300 L	
Min_500	Minimum oil price for 500 L	
Max_500	Maximum oil price for 500 L	
Mean_500	Average oil price for 500 L	

Range_500	Range of oil prices for 500 L	
STD_500	Standard Deviation of oil price for 500 L	
Min_900	Minimum oil price for 900 L	
Max_900	Maximum oil price for 900 L	
Mean_900	Average oil price for 900 L	
Range_900	Range of oil prices for 900 L	
STD_900	Standard Deviation of oil price for 900 L	
FirmusConn	Number of properties connected to Firmus in a Small Area	Gas
FirmusPass	Number of properties that could connect to Firmus in a Small Area	
PhoenxConn	Number of properties connected to Phoenix in a Small Area	
PhoenxPass	Number of properties that could connect to Phoenix in a Small Area	
SettBand	Urban Rural Settlement Band Code for 2015	Settlement type
UrbRur15	Urban Rural Settlement Band Description for 2015	
SOAHHBMIne	Anderson Income Measure	Income
SOAHHBMIeq	Anderson Income Measure	
SOAGini	Anderson Income Measure	
TMnShFal	COAMeanShortfall	Temperature
TMnTemp	COAMeanTemperature	
TMnDegD	COAMeanDegreedays	
AllRes	Total Population	Population and Age
Age0_5	Sum of ages 0 - 5	
Age65pl	Sum of ages 65+	
BadHlth	General health: Bad health	Health
VBadHlth	General health: Very bad health	
LP_DC16_74	All lone parent households with dependent children: Lone parent aged 16-74 years	Lone-parents
Hear	Type of long-term condition: Deafness or partial hearing loss	Health
Blind	Type of long-term condition: Blindness or partial sight loss	

CommDiff	Type of long-term condition: Communication difficulty	
Mobility	Type of long-term condition: A mobility or dexterity difficulty	
Learn	Type of long-term condition: A learning, intellectual, social or behavioural difficulty	
Mental	Type of long-term condition: An emotional, psychological or mental health condition	
LongPain	Type of long-term condition: Long-term pain or discomfort	
Breath	Type of long-term condition: Shortness of breath or difficulty breathing	
Memory	Type of long-term condition: Frequent periods of confusion or memory loss	
Chronic	Type of long-term condition: A chronic illness	
Other_1	Type of long-term condition: Other condition	
None	Type of long-term condition: No condition	
HearPC	Type of long-term condition: Deafness or partial hearing loss (%)	
BlindPC	Type of long-term condition: Blindness or partial sight loss (%)	
CommDifPC	Type of long-term condition: Communication difficulty (%)	
MobilityPC	Type of long-term condition: A mobility or dexterity difficulty (%)	
LearnPC	Type of long-term condition: A learning, intellectual, social or behavioural difficulty (%)	
MentalPC	Type of long-term condition: An emotional, psychological or mental health condition (%)	
LongPainPC	Type of long-term condition: Long-term pain or discomfort (%)	
BreathPC	Type of long-term condition: Shortness of breath or difficulty breathing (%)	
MemoryPC	Type of long-term condition: Frequent periods of confusion or memory loss (%)	
ChronicPC	Type of long-term condition: A chronic illness (%)	
OtherPC	Type of long-term condition: Other condition (%)	

NonePC	Type of long-term condition: No condition (%)	
H1_19UPCPW	Provides 1-19 hours unpaid care per week	Carers
H20_49UPCPW	Provides 20-49 hours unpaid care per week	
H50plUPCPW	Provides 50+ hours unpaid care per week	
AVGCVNE	Average domestic value in each Small Area	Property values
AVGPSIZE	Average property size in each Small Area	
AVGYEAR	Average year of property construction in each Small Area	

Section B: Geographical analysis

6.8 Geographical analysis

In 2011 the UK Census altered the lowest geographical area from Output Areas (N=5022) to Small Areas (N=4537). Small Areas are designed for statistical purposes and a wide range of socio-economic datasets are released at the Small Area (SA) level. Analysis at SA level ensures high precision in the results while also forming a consistent unit for finer data, such as those provided at postcode level.

The database contained 109 variables for each SA to indicate the extent of poverty, housing quality and vulnerability in each SA. The variables were subsequently weighted according poverty, housing quality and vulnerability with a final score produced for each SA ranging from 13.7 to 66.3. The higher the final score, the more eligible the SA is for the Affordable Warmth scheme. The main data groups used in the database are outlined below although more details are provided in Section A above.

6.9 Socio-economic datasets

A range of datasets relating to the population in each SA were sourced from the Northern Ireland Neighbourhood Information Service (NINIS). Data on benefits claimants were sourced from 2016 and joined to each SA. NINIS was used to source data on the main settlement type of each SA which ranged from "Open Countryside" to the main urban areas of Belfast and Derry. Data on the population for each SA was available and modified to give a count of the population that were aged between 0 and 5 years old and those aged 65 and above. Data on the number of lone-parents and carers in each SA was also sourced along with data on long-term health conditions. These socio-economic datasets were all mapped at SA level for all Northern Ireland.

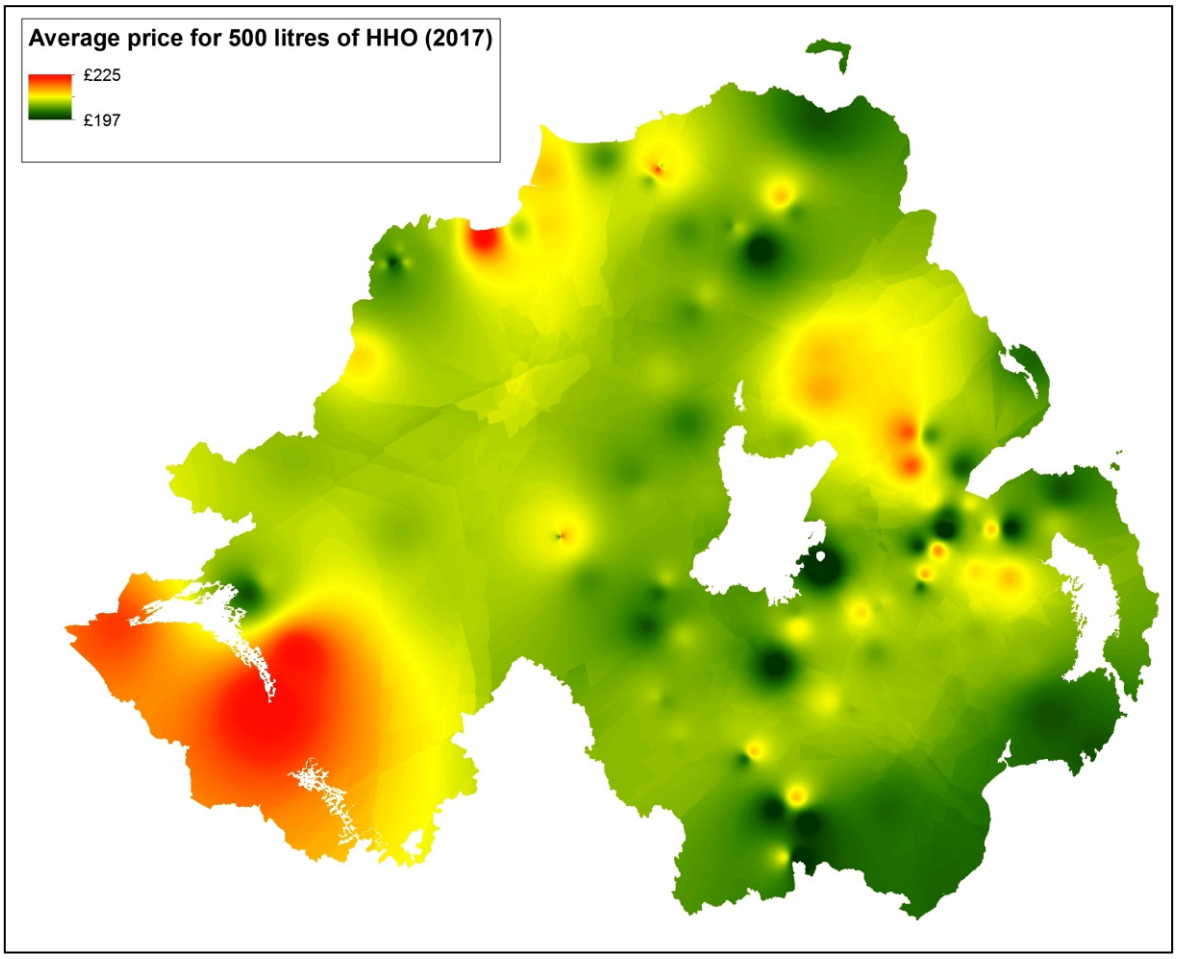
6.10 Household Energy datasets

Energy Performance Certificates were used to provide Standard Assessment Procedure (SAP) scores at postcode level for 2015. The SAP postcode data were mapped using the Central Postcode Directory (CPD 2016) to map 36,921 records of a total of 37,330 records (99% match). The dataset contained data on the number of properties used in each postcode, the average SAP rating for those properties and the average potential SAP rating for those properties. The point data for each postcode was joined to each SA in order to provide an average SAP rating and an average potential SAP rating for each SA.

6.11 Home Heating Oil prices

Home heating oil (HHO) prices were obtained for 300 litres, 500 litres and 900 litres for 115 oil suppliers during October and November 2017. These prices were obtained by using supplier websites and telephone calls and were mapped to ensure good geographic coverage (i.e. spread across all regions of Northern Ireland) as well as accurately reflecting local supply provision levels. Each supplier was mapped in ArcGIS and the price for 300L, 500L and 900L was interpolated using the 'inverse-distance-weighted' (IDW) method to create a continuous 'price surface' (Figure 1). The price surface was joined to each SA to give an average heating oil price for each SA.

Figure 10: Interpolated 500 litre home heating oil prices



6.12 Gas provision

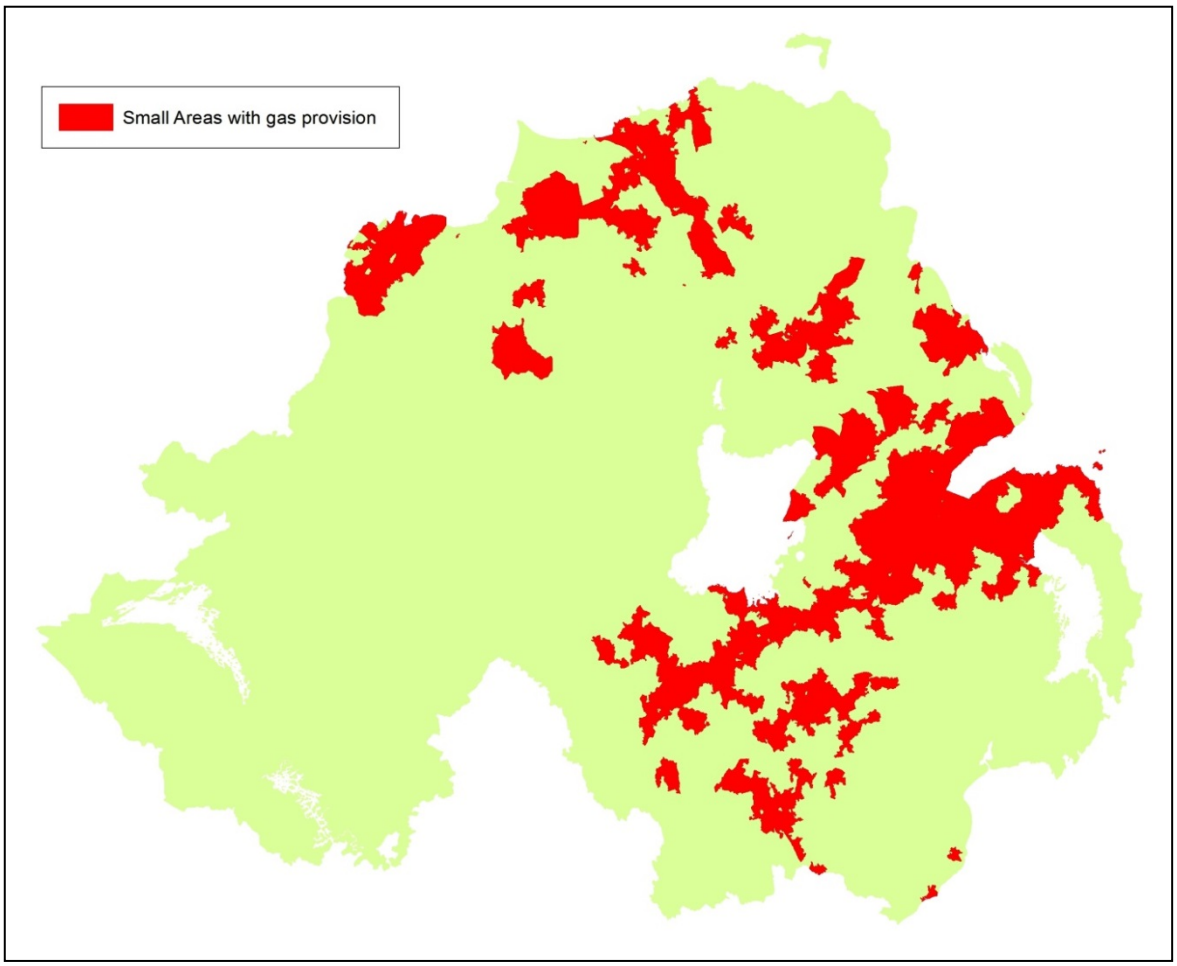
Firmus Energy and Phoenix Natural Gas are the two main gas providers operating in Northern Ireland.

Phoenix Natural Gas supplied data at postcode level for (a) postcodes that are connected and (b) postcodes that could be connected but currently are not connected. There were 13,923 postcodes with 318,898 properties that could be connected to Phoenix Natural Gas but are currently not connected. There were 13,341 postcodes with 200,423 properties that currently are connected to Phoenix Natural Gas. The Central Postcode Directory (CPD, 2016) and Pointer data were used to map the postcodes with a match of 99.8% for the postcode data.

Firmus Energy supplied data based on (a) properties that are, or could be, connected and (b) properties that are planned for connection. The data were supplied for individual houses based on a unique property reference number (UPRN) from Pointer. There were 100,329 properties that are currently connected or could connect to Firmus Energy. There were a further 12,669 properties that are planned from 2018 onwards. The Central Postcode Directory (CPD, 2016) and Pointer data were used to map the postcodes with a match of 98.6% for those properties that could currently connect to Firmus Energy. Of those properties that are planned, 97.7% of the data were mapped.

If a SA currently had gas provision, or was planned to have gas provision, a code of 1 was assigned. Of the 4,537 SAs in Northern Ireland, 2,930 (64.5%) had either gas currently or were planned to have gas available in the near future (Figure 2).

Figure 11: Small Areas with gas provision.



6.13 Property age and value

Land and Property Services (LPS) provide a domestic data product each year. This dataset contains a range of variables including capital value, property size and approximate year of build. This dataset was mapped where possible to individual domestic properties in the Pointer dataset to produce a dataset with the value, size and age of each domestic property. Capital values and property size were averaged for each SA based on the number of properties with values. Data were compiled by using the domestic dataset from both 2016 and 2017 to ensure less null values and a higher match of data. The data were compiled for each Council and were grouped into five age bands (table 5).

Table 5: Properties with year values for each of the 11 Councils.

Council	Properties with year values	1604 - 1919	1920 - 1944	1945 - 1969	1970 - 1999	2000 - 2017
Antrim & Newtownabbey	57097	3289	1685	13776	26628	11719
Ards & North Down	68163	6883	5223	12684	30745	12628
Armagh City, Banbridge & Craigavon	81104	9264	4150	9877	36703	21110
Belfast	104004	16504	27355	27836	30151	2158
Causeway Coast & Glens	61006	7695	3127	10372	25482	14330
Derry City & Strabane	59233	6758	1792	9384	29041	12258
Fermanagh & Omagh	46951	8729	882	6641	18624	12075
Lisburn & Castlereagh	57728	3681	2181	14343	25460	12063
Mid & East Antrim	57551	7515	3453	10055	25530	10998
Mid Ulster	51969	8301	1926	9397	18210	14135
Newry, Mourne & Down	66654	10261	2336	12252	25166	16639
TOTAL	**711460**	**88880**	**54110**	**136617**	**291740**	**140113**

Year values were mapped for each domestic property in order to remove from address lists those properties that were built post-2000 (see section 6.19).

6.14 Building type

LPS Pointer has a building classification for each property in Northern Ireland. This is divided into detached, semi-detached, terrace and apartments. Each property type was calculated as a percentage of the number of domestic properties in each SA.

6.15 Housing Executive properties

Data on Northern Ireland Housing Executive (NIHE) properties were supplied for September 2017. The Property Record, Allocations and Waiting List (PRAWL) contained all NIHE properties. This dataset was used to calculate a count of NIHE properties in each SA. Each individual NIHE property was also mapped to ensure that no NIHE properties were included in the address lists for each Council. Each domestic property was matched against all NIHE properties in ArcGIS and then all NIHE properties were removed from the domestic property list. The PRAWL database from 2011 was also incorporated in the database to show the extent of change in NIHE properties over time.

6.16 Income

The Anderson Measure was incorporated for each SA to indicate the level of poverty. The measure was released at Super Output Area (SOA) scale but was matched to SA to indicate poverty.

6.17 Temperature

Mean winter temperatures (December to March) were calculated for 18 meteorological stations across Northern Ireland and were mapped by interpolation (IDW method, cell-size, 50 m^2). The temperature values were originally created for each Census Output Area in 2011 and these values were matched to each SA using a lookup table.

6.18 Councils

In 2014, local councils were altered from 26 Districts to 11 Districts. In order provide meaningful data, statistics were produced for Small Areas in each of the 11 Council areas. Table 6 indicates the number of Small Areas in each of the 11 Councils.

Table 6: 11 District Councils and the number of Small Areas per Council

Council	Number of Small Areas
Antrim and Newtownabbey	352
Ards and North Down	441
Armagh City, Banbridge and Craigavon	467
Belfast	951
Causeway Coast and Glens	342
Derry City and Strabane	328
Fermanagh and Omagh	263
Lisburn and Castlereagh	345
Mid and East Antrim	369
Mid Ulster	294
Newry, Mourne and Down	385
TOTAL	**4537**

All maps and data were produced for each of the 11 Councils on an individual basis.

6.19 Affordable Warmth Programme (AWP) targeting

The AWP had targeted SAs in 2014 for each of the 11 Councils and these targeted SAs were removed from the list of eligible SAs for this algorithm. Based on the remaining SAs, the AWP eligibility score was sorted in descending order to highlight the top 70 SAs in terms of eligibility. These 70 SAs were used to identify all domestic properties that were (a) not NIHE properties and (b) not built post-2000. This process of excluding NIHE and post-2000 properties depends on the quality of the spatial data and there is a potential for some properties to be included. Each Council selected 50 SAs from which to select addresses for this algorithm. These 50 SAs were sorted and ranked and all domestic properties that were completely inside the 50 chosen SAs were selected. Each property was also assigned the SA code, the poverty score, the housing quality score, the vulnerability score, the AWP eligibility score and the rank of the SA.

LPS data are provided as part of the Northern Ireland Mapping Agreement (NIMA) of which Ulster University (UU) is a participant (NIMA S&LA 577.319)

Data on benefits and population counts is sourced from the Neighbourhood Statistics (NISRA) Website: www.nisra.gov.uk/ninis

In terms of when an algorithm such as this will need revision, there are a variety of new developments which would indicate a need for this. For example, whenever new data becomes available, particularly data which is strongly correlated with the criteria being used to assess eligibility for AWS. Alternatively, whenever there is a change in Fuel Poverty Strategy or in the policies associated with it. Most certainly, the publication of new Census data should trigger a revision too.